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BRIEFLY TOLD.

THE UTILITY AND VALUE OF STATE GAS COMMISSIONS.—In the aftermath of the 30th annual convention of the American Gas Light Association one's thoughts may easily revert to many of the interesting subjects there and then considered, one of which is especially prominent in the presidential message of Mr. Wm. R. Beal, that, from its importance and pertinence, deserves to be impressed upon the thoughtful attention, both of the manufacturers of gas and the framers of our laws. The JOURNAL commented briefly upon this matter in the issue dated November 17th, when it was said, in substance, that the address was replete with wise and timely suggestions as "To the salutary effect upon the gas industry as a whole, through legislation of the sort that resulted in the establishing of the Massachusetts Board of Gas and Electric Light Commissioners."

In order to refresh the memory of our readers we will quote from Mr. Beal's message:

"As our plants get to be known and are discussed by promoters and investors (changing owners as so many have with readjustment of bond and stock issues), conservative managers are looking to the establishment of State Gas Commissions and to that judicial treatment which will safeguard our properties against senseless competition and reckless exploitation. The time has come when we must look the situation squarely in the face and devote our best efforts as we have the opportunity to adjust ourselves to the rapidly approaching time when we must be content with an assured earning capacity equal to that secured by conservative management in other lines of business.

"In order to have this earning capacity assured protection must be afforded against attack by speculative interests, evil legislation and municipal assaults by corrupt politicians. It is probable that this protection can never be secured except by a State law, and we should all welcome legislation which would place our property on a sound financial basis, in exchange for which would be demanded the fair treatment of the public and a just division of profits, all of which we are professedly striving to give at present without any security as to the future. * * * In the estimation of many thoughtful men the time has arrived to secure protection through the establishment of State Gas Commissions, especially in our older States. I believe that the best interests of all companies supplying limited populations will be served by the creation of such commissions."

When a man of Mr. Beal's ripe experience, covering some 30 years of ardent competition and phenomenal extension of business, of his wide information and calm judgment, puts forth such positive advice to his associates, it commands serious consideration from all those interested in or affected by the lighting industries.

To claim that the Massachusetts Board of Gas and Electric Light Commissioners is a perfect instrument for the purposes of its creation, and that it has made no mistakes, would be absurd. It was at first an experiment which was viewed with many misgivings by those most competent to criticize, and the powers with which it was clothed might, in a body less conscientious and conservative, have resulted in serious damage to the properties under its supervision. The fact that results have proved more satisfactory, and errors less frequent and grave than was

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feared by many, is highly creditable to the personnel of the Commission and fully justifies its creation. The practice by Commissioner Barker of attending the various conventions of the lighting associations throughout the country, and so becoming familiar with the technical side of the questions considered by the Commission, is particularly to be commended, and might with benefit be inculcated as a duty in the formation of any similar body. The publicity given to the accounts of the lighting companies by the Commission is not to an extent which might be deemed objectionable, while it is sufficient to acquaint the investing public with the true state of their average earnings, and protects it against false and misleading representations of promoters exploiting competing schemes.

In like manner complaints and demands of the citizens, which are frequently seized upon by demagogic politicians as opportunity for municipal assaults, are investigated and rectified in a spirit of fairness, alike beneficial to the properties and to the people. Such information as is collected, compiled and published by a Board of Commissioners, even if given directly by the lighting companies, would be looked upon with distrust by the public as coming from an interested party, no matter how highly it esteemed the individual managers, and hence would fail in the salutary effect sought for in such publicity. Explanations offered by the companies for excessive charges, interruptions to supply, accidents encountered, and the many other causes for complaint on the part of the public, have not the satisfying power of an investigation made by an impartial tribunal; and the cost of arriving at a final adjustment would be much less to all parties if referred to a board of commissioners than to either the courts or the legislatures. The questions submitted to such a commission have to deal largely with technical matters, and the conditions affecting them are as varied as the localities in which they arise; a commission soon becomes expert in considering them and is able to save time as well as money in solving them. The public demands fuller knowledge of the business and methods of those supplying its needs and enjoying its franchises; the framers and executors of our laws need the advice of men especially informed upon questions relating to public utilities, such as the members of a gas commission soon become; and, in exchange for the power given such a commission over the affairs of private corporations and properties, and the private information intrusted to it, these properties deserve and will doubtless be given full protection in the enjoymeht of a fair return upon the business risks and investments. Is it not deserving of a more extended trial along the lines so happily indicated in the Massachusetts experiment?—"B."

NOTES.—

MR. HENRY M. HOWE, Professor of Metallurgy, Department of Metallurgy, Columbia University, N. Y., informs us that Mr. Bradley Stoughton, instructor in metallurgy, will deliver a lecture on "The Manufacture of Coke in By-Product Ovens," in Room 103, Havemeyer Building, Columbia University, at 8 P.M. of the 10th inst. The lecture will be illustrated on the lantern slide plan, and all interested are invited to attend. No tickets of admission are required. It is a pity that an earlier notice of this could not have been given, for with fair forewarning many local gas men would undoubtedly have arranged to attend the lecture. We hope to reproduce it in type later on.

WITH much regret we report the death of Mr. Julius Buss, who passed away, at his home in Dortmund, Germany, the night of the 23d ult. Deceased, who was in his 43d year, served his apprenticeship in the gas business under the tutelage of Mr. August Kloenne, of Dortmund, first taking service with him in 1879. The 1st of November, 1889, he came to America and entered the employ of Mr. Frederic Bredel, whose headquarters at that time were in New York city. He suffered from illness considerably during the last 2 years, and his return to Europe (made last September) was prompted by the hope that the change would benefit him. Mr. Buss was an associate member of the American Gas Light Association, and of the Western Gas Association as well.

THE gas war in San Francisco seems to have reached the point where even the Spreckles are considering its cost—to them.

Determination of Water in Tar.[1]

By HERR BECHER, Chemist to the Frankfort (Germany) Gas Company.

Buyers of tar often enough complain that there is too much water in the tar. The water in such cases seems to be distributed through the tar in the form of minute droplets which are not able to come up to the surface of the viscous tar, especially since the imprisoned water is in many cases so rich in ammoniacal salts that it is not far from being as heavy as the tar itself.

After numerous attempts, Herr Becker has come upon a plan for estimating the quantity of water in tar which is quite expeditious. His apparatus is shown in Fig. 1. *A* is a large glass flask of 4 or 5 liters (say 1 gallon) capacity, nested in asbestos on wire gauze over a Bunsen *B*. *C* is a Liebig's condenser, the central tube of which is continuous with the worm of the condenser *D*, which worm opens into the receiver *E*. This receiver is tubular, and has a stopcock below. *V* is a vacuum flask, connected with the Sprengel air pump *P*, worked by the water supply. The vacuum flask is connected with a manometer *M*, and also, by the pipe *G*, with the bulbs shown in the tube *H*, and ultimately with the receiver *E*. Another water stopcock sends water up through the tube *H*, round the bulbs contained in that tube, on to the lower part of and through the Liebig's condenser *C*, and along *J*, round the worm in *D*, and away at *O*. At *I* there is a pinch stopcock, opening to the outer air; and at *K* there is another, opening the receiver *E* to the outer air. About a kilogramme (2.2 pounds) of tar is put into *A*, and the apparatus is connected up; the stopcock *I* is closed and *K* opened; the tar is heated until it begins to give off numerous small bubbles. *K* is then closed and the air pump adjusted to make the mercury column in the manometer stand at 40 cm. (16 inches). The tar soon begins to froth violently. When it comes up to the neck a short squeeze at *I* lets in the outer air, which promptly drives back the froth. This play is kept up until the tar is pretty well deprived of its water and becomes tranquil. On further heating, the vacuum being meanwhile raised to 70 cm. (28 inches), the tar gives off oils; the blackened walls of the flask are washed clear. When this stage is reached the operation is stopped; *I* is opened and the air pump *P* slowly put out of action by shutting off its water supply. The water and the oil distilled from the tar form two layers in *E*. The water stands below the oil, and may be run off and weighed. The whole operation takes about three-quarters of an hour. If by chance any of the froth gets up into the condenser *C*, we open, not the stopcock *I*, but the stopcock *R*, at the top of the worm *D*; air runs in and drives the froth back from *C* into *A*.

The apparatus can also be used for estimating the oils. For this, as soon as the naphthaline begins to separate, the water supply to the condensers is to be cut off by taking the rubber tube off the water stopcock. The water in the condensers *C* and *D* will then all run out.

The vacuum must be kept well up, so that the admission of the outer air may have the effect of repressing the froth. It may, however, prove necessary to lower the flame if the frothing is too vigorous.

The method is very simple, and hundreds of analyses have been made at Frankfort by these means. The results are very exact, the return being from 98½ to 99.6 per cent. of the exact total amount of water present in the tar.

Fig. 2 illustrates the author's method of taking samples of tar. It shows an iron cylinder 4 inches in diameter and 40 inches long, terminated below by a cone with aperture 1.6 inches wide closed by a heavy conical plug worked by a rod. The lower aperture is opened and the sampler is let down into the tank; the plug is then sent home and the sampler is lifted out. Then the plug is released and the liquid is allowed to flow out and is mixed. The apparatus is stored in a tank filled with tar oils or benzol to prevent it from clogging.

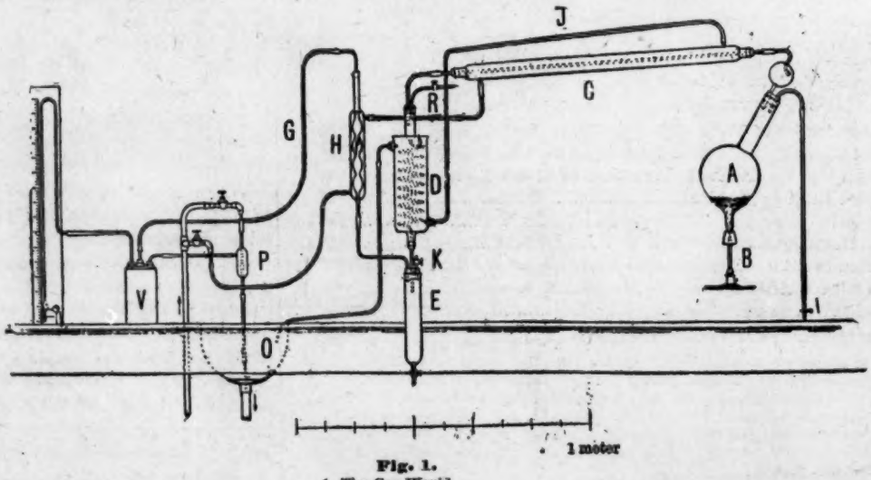


Fig. 1.

1. The *Gas World*.

Fig. 2

Coal Unloading and Conveying Plant at the Nancy Gas Works.[1]

Nancy is the principal town in French Lorraine, and has a population of about 100,000. It is an industrial center, and has risen to great prosperity since the time of the Franco-German war—its population has nearly doubled in the interim, owing mainly to migrations from the adjacent districts which were made over to the German Empire when peace was declared. The gas works have consequently also had to be enlarged several times, to keep pace with the growth of the place.

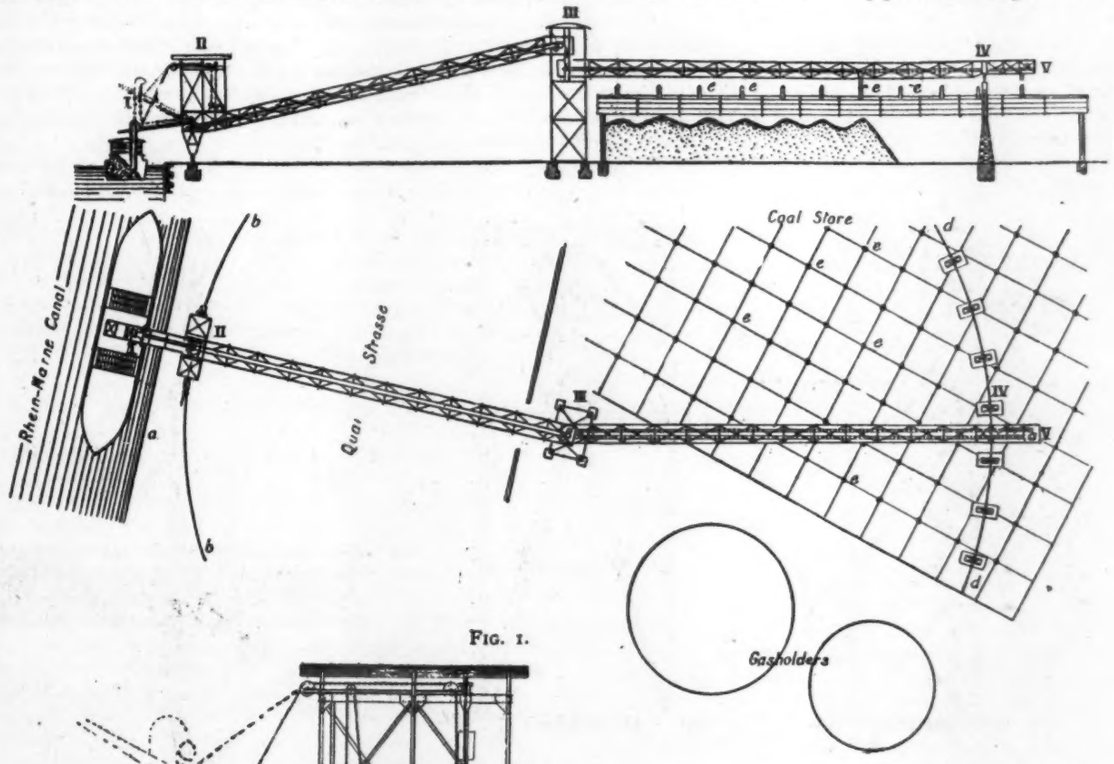


FIG. 1.

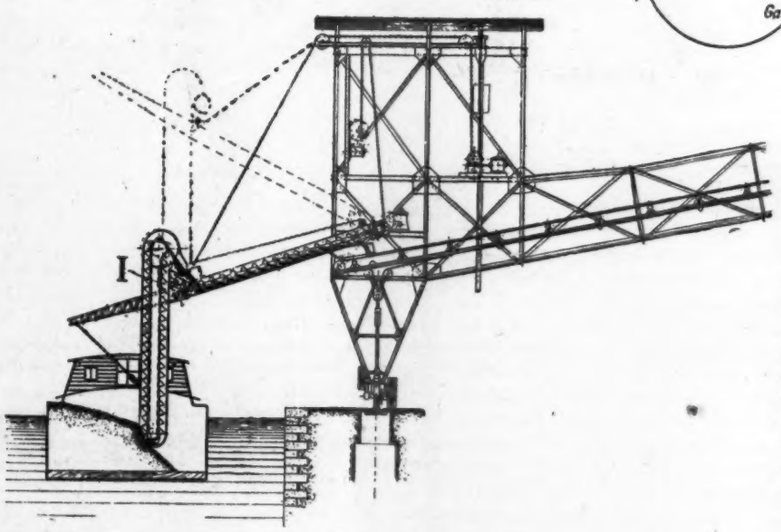


FIG. 2.

The establishment of electricity works checked for a time the rapid increase in the demand for gas, but caused no permanent falling off in the prosperity of the gas undertaking.

The coal for gas making is obtained from the Saar field and the Belgian frontier; and, thanks to the fine system of canals existing in France, it can be brought to Nancy most cheaply by water. The gas works were consequently long ago built close to a quay on the Rhine-Marne Canal, which naturally runs through the low lying parts of the town. The position is, therefore, a very suitable one. Moreover, the canals in France are free from ice nearly all the year; the stoppage of navigation on the Rhine-Marne Canal extends on the average only for some 40 days a year. Thus there is no

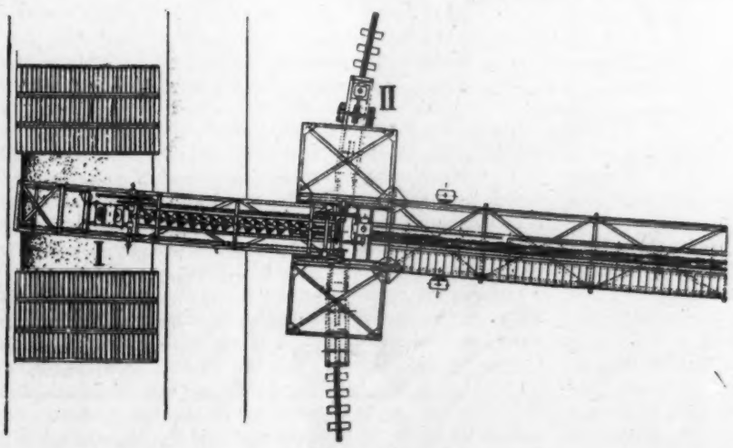


FIG. 3.

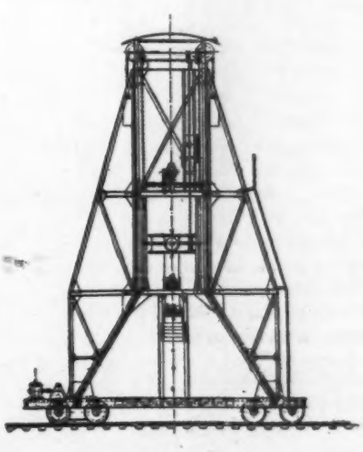


FIG. 4.

[1] Journal of Gas Lighting.

necessity, on this account, to lay in a large store of coal; but the frequent occurrence of strikes in the coal districts during recent years points to the wisdom of keeping a good stock on the works.

The old method of unloading the cargoes by hand became less and less satisfactory as the quantities to be dealt with increased; and the rates of pay of workmen continually went up. Hence the authorities of the works decided, notwithstanding the considerable outlay entailed, to put in unloading and conveying machinery of the latest pattern, driven by electrical power. The installation was carried out jointly by the firms of G. Mourraille and A. Michelin, both of Paris; and as it embodies many interesting details, we give below some particulars taken from a description by M. Keppler, which has been published, with the illustrations here reproduced on a somewhat smaller scale, in a recent number of the *Journal für Gasbeleuchtung*.

The movable bucket elevating apparatus (Figs. 1 to 3) raises the coal vertically from the ship's hold, and discharges it on to the endless screw I.—II., which terminates at the pier II., at a height of about 16 feet 6 inches above the quay wall (Fig. 2). The coal is then taken up by the endless conveying band II.—III. (Fig. 1), and carried overhead across the quay street to the pier III. (Figs. 5 to 7) within the works.

It reaches this pier at a height of about 42 feet 6 inches from the ground level. In order that a longer stretch of foreshore may be accessible with the elevator, the whole of the structure indicated by I., II. and III. is made so that it may be moved about a pivot on the fixed pier III., by means of a carriage with two wheels traveling on a single-rail track *b b* (Figs. 1 and 5).

The coal-store to be filled extends to the left of the projection of the line I.—II.—III., while the large gasholders are to the right of it. Over

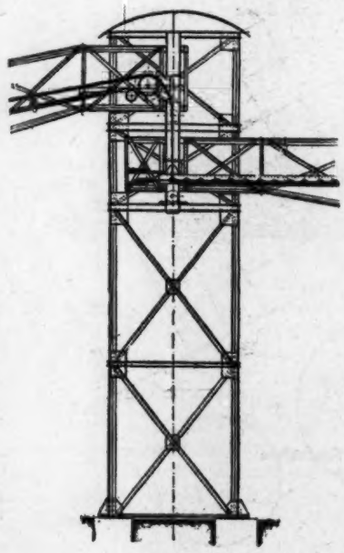


Fig. 5.

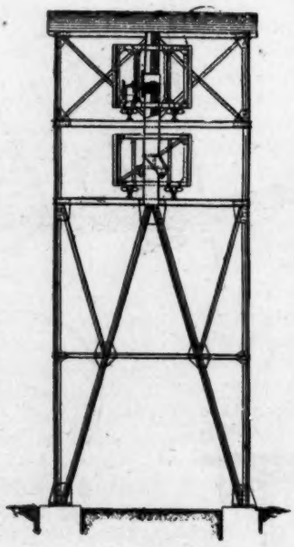


Fig. 6.

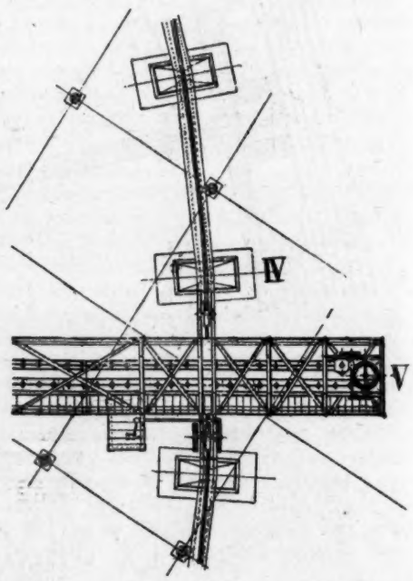


Fig. 10.

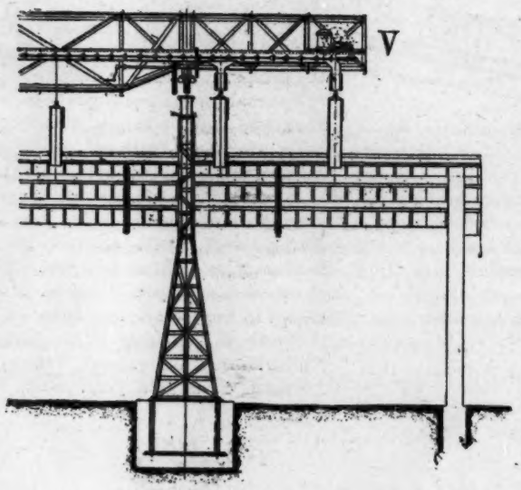


Fig. 8.

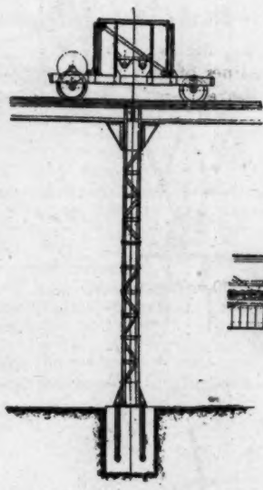


Fig. 9.

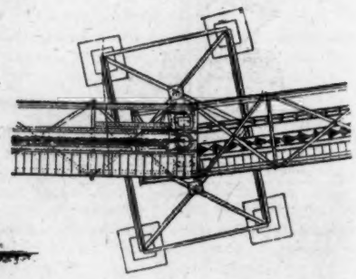


Fig. 7.

Though the site of the gas works is so favorably situated on the quay street of the canal wharf, it is hemmed in on the one side by the site of an abattoir, and on the other by the Rue du Faubourg St. Georges. Consequently, it was essential that the available space should be utilized to the very best advantage.

It will be seen from the illustration (Fig. I), which shows the general scheme of the plant, as well as from the plans of various portions which follow, that at the point II. on the bank of the canal there is a pier, which travels on the single rail track *b b*. This pier carries on the outside an elevator 33 feet in length, which can be drawn up, and comprises a horizontal or inclined screw conveyor and a vertical bucket elevator. On the inside, towards the works, is a bridge 50 feet in length, connecting the travelling pier with the fixed pier III., and rising at an angle of 18° in the direction of the latter. This bridge carries an endless conveying band.

the roofs of the coal store there is a horizontal traveling bridge, III.—IV.—V., 184 feet long, extending from pier III., on which it is pivoted. It travels, by means of rollers at IV., on a single-rail track *d d*, supported by fixed piers (Figs. 1, 8 and 10). This bridge, which is 30 feet 6 inches above the yard level of the works, carries a horizontal chain conveyor, and, through its moving horizontally, passes over the whole of the roofs of the underlying coal shed.

Openings (*e*) for shooting in the coal are provided at suitable distances apart in the specially shaped roofs of these sheds (Figs. 8 and 9), and these openings are connected, by means of moveable troughs, with corresponding places in the chain conveyor. The coal sheds may be thus perfectly uniformly filled by purely mechanical means, and with freedom from any manual labor, in the shortest possible time. Both the contracting firms have guaranteed that the installation will be able to convey 30 tons of coal per hour, and that the machinery will require

the attendance of only one fitter and one experienced hand. Four day laborers will at the same time be wanted in the barge to break up the coal and bring it up to the elevator.

The whole of the iron structure and the conveying apparatus weighs about 65 tons, and has cost $15,000; while the complete installation, including electro-motors and accessories, will entail an outlay of about $20,000. Its erection was begun in the autumn of last year, and it was ready for work last spring. Details of the working, when available, will form very interesting reading.

Steam Pipe Covering and its Relation to Station Economy.[1]

Before awarding a contract for covering the steam pipes in the Manhattan Railway Company's power house, a careful investigation and test of different types and thicknesses of covering was made under the author's direction. In order to get the necessary data it was decided to carry out a complete test of the various types of covering on the mar ket, and also to investigate the effect of varying the thickness of the insulating wall.

The method adopted is illustrated in Fig. 1, and consisted in coupling

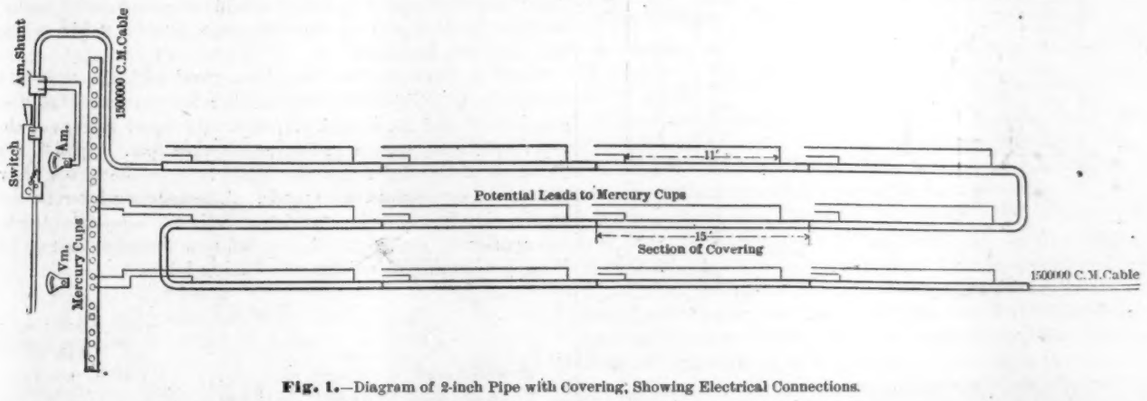


Fig. 1.—Diagram of 2-inch Pipe with Covering, Showing Electrical Connections.

up about 200 feet of 2-inch iron pipe and mounting the same on wooden horses about 3½ feet from the floor, the three lines of pipe being approximately 4 feet apart and 4 feet from the nearest wall, in order to avoid any errors due to heat connection and radiation. Sections 15 feet in length were marked off on the straight portions of the pipe, and so arranged as not to include any pipe couplings or bends; 2 feet from each end of each section heavy potential wires were soldered on to the pipe, and at the extreme ends of the pipe 1,500,000 cm. copper insulated cables were soldered on, the openings in the pipe having been previously closed by means of a standard coupling and plug. One of these cables ran direct to one terminal of a 250-kw. 250-volt, steam driven, direct coupled exciter, which was solely devoted to furnishing current for the test, and which could have its voltage varied within wide limits so as to furnish any current up to 1,500 amperes. The cable connected to the other end of the pipe was then connected to three ammeter shunts in series, in order to enable the readings to be easily checked, after which it was carried through a circuit breaker and switch to the other exciter terminal. The pipe covering test was carried on in a vault in which there was no source of heat and no possibility of draughts of air, and arranged so that the section in which the test was being carried on could be locked up in order to prevent interference with the test.

Invitations for bids were sent to all the principal pipe covering manufacturers and jobbers, specifying that each one would be expected to cover one or more sections of the 2-inch pipe for a competitive test, and that samples from the successful bidders' covering would be analyzed in the company's chemical laboratory, and no covering accepted which departed more than 3 per cent. from this analysis.

A special Weston milli-voltmeter was ordered, with which readings were taken from the potential wires, the latter all being brought to mercury cups on a testing table near which the ammeters were also located.

Preliminary tests were made with a small current in order to establish the individual resistance of the 11-foot sections between the potential wires; this current was then gradually increased and more readings taken together with thermometer readings from thermometers having their bulbs in contact with the pipe at an angle of about 30°, the stems projecting through the covering. From these readings a coefficient of .4649 per cent. increase of resistance per degree centigrade was determined, and afterwards used in determining temperatures of the various sections. At first it was thought that temperatures could be determined with sufficient accuracy by the thermometers, inserted as above described in the center of each section covered, but after a preliminary series of readings this was abandoned as inaccurate, owing, no doubt, to the variable contact made by the bulb on the bare pipe. All temperatures were, therefore, calculated by the resistance method.

Current sufficient to heat the pipe to approximately 370° F. (corresponding to a steam gauge pressure of 160 pounds) was kept on for 3 days continuously, in order to dry out the various coverings, after which they were allowed to cool off to the air temperatures before starting the test. The temperature of the room was kept between 27° C. and 31° C. during the entire test, each section had about 600 readings taken, and where any doubt existed in reference to readings, the entire series was gone over a second and third time with the gratifying result that it was conclusively shown that the test could be repeated with a variation of results not exceeding 2 per cent.

The method of test was to put a current of sufficient quantity through the pipe to heat it to say 220° F., and keep this current on for a sufficient time to enable all sections to maintain a constant temperature (this period was found to be about 10 hours) when readings of the milli-voltmeter were taken on each section with simultaneous ammeter readings. As all the sections were in series electrically, the current was, of course, the same, so that no error could arise, due to variation of current.

The object of leaving 2 feet at the end of each section, or 4 feet between potential wires, was to avoid any error due to conduction of heat through the pipe. Tests were made to prove the efficiency of this precaution, and showed that no perceptible error was introduced.

A constant temperature having been obtained, it is evident that the watts lost in each section give an exact measure of the energy lost in maintaining a constant temperature, and from the watts lost the thermal units are readily calculated. Fig. 2 shows the result of the test values being reduced to loss in B.T.U. per square foot of pipe surface at various temperatures in the curves, and at a temperature corresponding to steam at 160 pounds pressure in the table.

After a series of readings had been completed, the current was raised sufficiently to give approximately 50° F. rise in the least efficient covering, and maintained constant for 10 hours, when another series of readings were taken, and so on until the temperature of the pipe had reached a point far above anything used in practice. The extremely high readings were taken as a matter of interest, as they were got when the low efficiency coverings were only at working temperatures.

Referring to the table in diagram Fig. 3, the first column refers to the number of curves, the second column gives the name of the covering which, in most cases, is sufficiently descriptive, but a brief description of each covering may be of interest.

No. 2. Solid sectional covering, 1½ inches thick, composed of granulated cork moulded under pressure, and then baked at a temperature of 500° F., ¼-inch asbestos paper next pipe, finished with resin paper and 8-ounce canvas.

No. 3. Solid 1-inch moulded sectional covering, composed of 85 per cent. carbonate of magnesia, finished with resin paper and 8-ounce canvas.

No. 4. Solid 1-inch sectional covering, composed of granulated cork moulded under pressure and baked at a temperature of 500° F., ¼-inch asbestos paper next pipe, finished with resin paper and 8-ounce canvas.

1. From a paper by Mr. H. G. Stott, read before the last Convention of the Association of Edison Illuminating Companies.

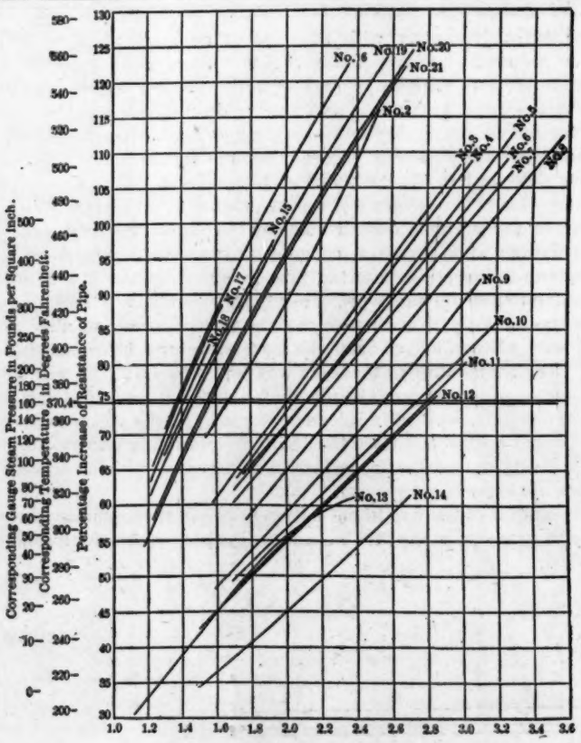


Fig. 2.—Results of Test Values.

No. 5. Solid 1-inch moulded sectional covering, composed of 85 per cent. carbonate of magnesia. Outside of sections covered with canvas pasted on. Finished with resin paper and 8-ounce canvas.

No. 6. Laminated 1-inch sectional covering, composed of nine layers of asbestos paper with granulated cork in between; outside of sections covered with canvas pasted on, ½-inch asbestos paper next pipe, finished with resin paper and 8-ounce canvas.

No. 7. Solid 1-inch moulded sectional covering, composed of 85 per cent. carbonate of magnesia, outside of sections covered with light canvas pasted on; finished with resin paper and 8-ounce canvas.

No. 8. Laminated 1-inch sectional covering, composed of seven layers of asbestos paper indented with ½-inch square indentations, which serve to keep the asbestos layers from coming in close contact with one another; ½-inch asbestos paper placed next pipe, finished with resin paper and canvas.

No. 9. Laminated 1-inch sectional covering, composed of 64 layers of asbestos paper, in which were imbedded small pieces of sponge. Outside covered with canvas pasted on, finished with resin paper and canvas.

No. 10. Laminated 1½-inch sectional covering composed of 12 plain layers of asbestos paper, with corrugated layers in between, thus forming longitudinal air cells; ½-inch asbestos paper next pipe; sections wired on and finished with resin paper and 8-ounce canvas.

No. 11. Laminated 1-inch sectional covering, composed of 8 layers of asbestos paper with corrugated layers in between, the corrugations forming small air ducts radially around the covering; finished with resin paper and 8-ounce canvas.

No. 12. Laminated 1½-inch sectional covering, composed of 6 layers of asbestos paper with corrugated layers, forming longitudinal air cells; outside of sections covered with two layers of canvas pasted on and finished with resin paper and canvas.

No. 13. Solid 1-inch moulded sectional covering, composed of a magnesia compound mostly talc; ½-inch asbestos paper next pipe; finished with resin paper and 8-ounce canvas. This sample was submitted for low temperature work only, such as boiler feed and drips.

No. 14. Solid 1-inch moulded sectional covering, composed of magnesian compound, principally talc; ½-inch layer of asbestos paper next pipe and finished with resin paper and 8-ounce canvas.

No. 15. "Remanit," composed of two layers wound in reverse direction with ropes of carbonized silk. Inner layer 2½ inches wide and ¼ inch thick; outer layer 2 inches wide and ¼ inch thick, over which was wound a network of fine wire; ½-inch asbestos next pipe, finished with resin paper and 8-ounce canvas. Made in Germany.

No. 16. Two and one-half inch covering, composed or 85 per cent carbonate of magnesia, ½-inch blocks about 3 inches wide and 18 inches long next pipe and wired on; over these blocks were placed solid 2-inch moulded sectional covering; outside covered with canvas pasted on. Finished with 8-ounce canvas.

No. 17. Two and one-half inch covering, composed of 85 per cent. magnesia. Put on in a 2-inch moulded section wired on; next the pipe and over this a ½-inch layer of magnesia plaster covered with canvas pasted on and finished with 8-ounce canvas.

No. 18. Two and one-half inch covering, composed of 85 per cent. carbonate of magnesia. Put on in two solid 1-inch moulded sections with ½-inch layer of magnesia plaster between; two 1-inch coverings wired on and placed so as to break joints. Finished with 8-ounce canvas.

No. 19. Two-inch covering, composed of 85 per cent. carbonate of magnesia put on in two 1-inch layers, so placed as to break joints, and finished with 8-ounce canvas.

No. 20. Solid 2-inch moulded sectional covering, composed of 85 per cent. magnesia; outside of sections covered with canvas pasted on. Finished with 8-ounce canvas.

No. 21. Solid 2-inch moulded sectional covering, composed of 85 per cent. magnesia; outside of sections covered with canvas pasted on. Finished with 8-ounce canvas.

Nos. 2, 4, 6 and 15 were excluded by the specifications, which stated that "no inflammable material would be considered;" but a test was made at the request of the manufacturers in order to give a comparison with the other materials.

It will be noted that two samples covered with the same thickness of similar material give different results; for example, Nos. 3 and 5 and also Nos. 20 and 21, though of practically equal thickness, show quite a perceptible difference in loss per square foot. Upon investigation, the cause of this difference was found to be in the care with which the joints between sections were made. A comparison between Nos. 19 and 20, showing two coverings having exactly the same total thickness, but one applied in a solid 2-inch section, and the other in two 1-inch sections, proved the desirability of breaking joints.

TABLE I.

Covering.	Aver. Thick. Inch.	B.T.U. Loss per sq. ft. at 160 lbs. Pr	Per Cent. Heat Saved by Covering.
2. Solid cork: Sectional	1.68	1.672	87.1
3. 85 per cent. Magnesia: Sectional	1.18	2.008	84.5
4. Solid Cork: Sctional	1.26	2.048	84.2
5. 85 per cent. Magnesia: Sectional	1.19	2.130	83.6
6. Laminated Asbestos Cork: Sectional.	1.43	2.123	83.7
7. 85 per cent. Magnesia: Sectional	1.12	2.190	83.2
8. Asbestos Air Cell [Indent]: Sectional [Imperial]	1.26	2.333	82.1
9. Asbestos Sponge Felted: Sectional	1.24	2.556	80.3
10. Asbestos Air Cell [Long]: Sectional.	1.70	2.750	78.8
11. "Asbestocel" [Radial]: Sectional	1.22	2.801	78.5
12. Asbestos Air Cell [Long]: Sectional.	1.29	2.812	78.4
13. "Standard" Magnesia: Sectional	1.12	....	....
14. "Magnesian": Sectional	1.23	....	....
15. "Remanit" [Silk]: Wrapped	1.51	1.452	88.8
16. 85 per cent. Magnesia: 2" Sectional and ½" Block	2.71	1.381	89.4
17. 85 per cent. Magnesia: 2" Sectional and ½" Plaster	2.45	1.387	89.3
18. 85 per cent. Magnesia: 2-1" Sectional and ½" Plaster	2.50	1.412	89.1
19. 85 per cent. Magnesia: 2-1" Sectional.	2.24	1.465	88.7
20. 85 per cent. Magnesia: 2" Sectional	2 24	1.555	88.0
21. 85 per cent. Magnesia: 2" Sectional	2.21	1.568	87.9
Bare Pipe [From Outside Tests]	....	13.000	....

Fig. 3.—Record of Tests.

An attempt was made to determine the law governing the effect of increasing the thickness of the insulating material, and for all the 85 per cent. magnesia coverings the efficiency varied directly as the square root of the thickness, but the other materials tested did not follow this simple law closely, each one envolving a different constant.

The column on the right of the accompanying table shows the percentage of heat saved by the different coverings, compared to bare pipe, at a pressure of 160 pounds.

In Table II. (Fig. 4) an attempt has been made to reduce all coverings to the same thickness, and thus show the relative efficiency of different types of material at a wide range of pressures. One-inch covering was adopted as the standard, and only those covering nearly 1½ inches thick

TABLE II.—*Total Expense Cost of Covering and Heat Loss.*

Thickness.	First Cost.	$10,000 Per Cent. 1st Cost.	$10,000 Per Cent. Loss.	$20,000 Per Cent. 1st Cost.	$20,000 Per Cent. Loss.	$30,000 Per Cent. 1st Cost.	$30,000 Per Cent. Loss.	$40,000 Per Cent. 1st Cost.	$40,000 Per Cent. Loss.	$50,000 Per Cent. 1st Cost.	$50,000 Per Cent. Loss.	$60,000 Per Cent. 1st Cost.	$60,000 Per Cent. Loss.
1.25″	$5,550	55.5	44.5	27.8	72.2	18.5	81.5	13.9	86.1	11.1	88.9	9.3	90.7
2.00″	7,880	78.8	21.2	39.4	60.6	26.3	73.7	19.7	80.3	15.8	84.2	13.1	86.9
2.50″	8,660	86.6	13.4	43.3	56.7	28.9	71.1	21.7	78.3	17.3	82.7	14.4	85.6
3.00″	9,550	95.5	4.5	47.8	52.2	31.8	68.2	23.9	76.1	19.1	80.9	15.9	84.1

Fig. 4.—Relative Efficiencies.

were used in the comparison in order to avoid errors in calculating the losses in materials which did not follow the square root law closely.

An inspection of the table shows that the carbonized silk covering is the most efficient, having a relative efficiency of 86.9, whilst 85 per cent. magnesia comes second with 84.2 per cent. efficiency. The two other samples of 85 per cent. magnesia show efficiencies of 83.1 and 83.2 per cent., thus confirming in a remarkable way the results on the other samples.

Relation to Station Economy.—To determine which covering is the most economical, the following quantities must be considered:

1st. Investment in covering. 2d. Cost of coal required to supply lost heat. 3d. Five per cent. interest on capital invested in boilers and stokers rendered idle through having to supply lost heat. 4th. Guaranteed life of covering. 5th. Thickness of covering.

From an inspection of the first three quantities it is apparent that the covering which shows a minimum total cost of the three at the end of a specified time is the best covering to adopt, for the loss in heat at the end of 10 years may readily cost over 3 times as much as the first cost of covering. To enable this to be seen more clearly, Table III. was calculated (Fig. 5).

TABLE III.

Covering.	B.T.U. Loss per sq. ft. at 150 lbs. Pr.	Per Cent. Heat Saved by Covering.
3. 85 per cent. Magnesia: Sectional.....	2.060	84.2
4. Solid Cork: Sectional.....	2.170	83.3
5. 85 per cent. Magnesia: Sectional.....	2.192	83.1
6. Laminated Asbestos Cork: Sectional.....	2.395	81.6
7. 85 per cent. Magnesia: Sectional.....	2.184	83.2
8. Asbestos Air Cell [Indented]: Sectional ["Imperial"].....	2.465	81.0
9. Asbestos Sponge Felted: Sectional.....	2.683	79.4
10. Asbestos Air Cell [Long]: Sectional	3.380	74.0
11. "Asbestocel" [Radial]: Sectional.....	2.920	77.5
12. Asbestos Air Cell [Long]: Sectional	3.015	76.8
13. "Standard" Magnesia: Sectional.....	....	....
14. "Magnesian": Sectional	....	....
15. "Remanit" [Carbonized Silk] Wrapped..	1.708	86.9
Bare Pipe [From Outside Tests.....	13.000	....

Fig. 5.—Heat Saved by Covering.

A specific number of square feet of pipe surface has been used in working out the total cost, but it is evident that the curves may be used to determine the most economical thickness of covering, irrespective of the total amount of surface to be covered, as long as the cost per square foot of material for different thicknesses varies in the same manner as for 85 per cent. magnesia, which has been used in calculating the accompanying tables.

As the geometrical dimensions of the covering are a function of the cost of the increased thickness desired, it will generally be found that increasing the thickness of the material will increase the investment in a manner similar to that shown in the curves for 85 per cent. carbonate of magnesia.

An inspection of the curves showed that before deciding upon what is the most economical thickness of covering to be used, it is first of all necessary to know how long the covering is expected to last. For example, suppose that a temporary plant is being erected which is not likely to be required for more than two years, a 1-inch covering will be the most economical. For covering guaranteed for 10 years, as required by the Manhattan Railway Company, 1-inch covering would show a total cost of $53,663, whilst a 3-inch covering would show a total cost of $38,668, making a net saving of $14,995 at the end of 10 years, or $1,499.50 per annum, which, capitalized at 5 per cent., represents $29,990.

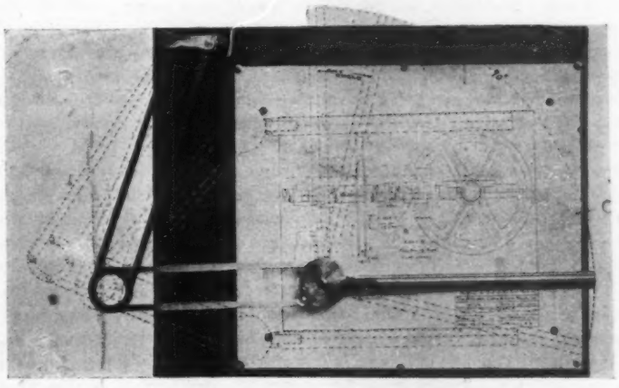
From the above example, it will be seen that whilst pipe covering is a relatively small portion of the many problems confronting the engineer, yet its scientific solution will yield rich results out of all proportion to the time required to solve it.

I would only add that there seems to be no reason for the former practice of putting on different thickness of covering on different sized pipes, excepting the mechanical difficulty of applying a very heavy covering to a small pipe. This difficulty can be overcome by putting the covering on in two separate layers, and this plan should be used on all sizes in order that the joints may be broken, as poor joints may reduce the efficiency of the best covering 6 per cent. or more.

A New Drafting Machine.

Engineering Record notes that a drafting device of considerable merit, because of its simplicity and adaptability to all kinds of drawings, has lately been put on the market by the Universal Drafting Machine Company, of Cleveland, O. This new instrument is call "The Rapid Sketching Device," and is similar in construction to a larger and more expensive universal drafting machine manufactured by the same company. The striking advantage of the machine at first glance is that it combines the T-square, triangles, protractor and scale all in one. The manufacturers claim that a saving of half the time required by ordinary means is effected by their apparatus, since with it the draftsman can draw a line the exact required length at one operation, and may do angular work with as great facility as straight.

The apparatus consists of an ordinary drawing board, to the upper left hand corner of which is attached a mechanism for maintaining a movable scale always in positions parallel with its first setting. This is accomplished by two pivoted parallelograms, which in their action may be compared with the arm, elbow and hand of a man with his shoulder at the corner of the board, and possessing the ability to move the scale



How to Use the Rapid Sketching Device.

to any part of the board, while continually pointing it in the same direction. The hand feature consists of two circular plates, between which, and on a stud through their centers, is mounted a lug carrying the scale. The lower plate is pivoted to the rods of the arm and cannot rotate. The upper plate serves as a protractor and may be revolved to any position and clamped by a set-screw. It carries two stops on its lower face, which are adjustable to provide for wear or disarrangement. The scale, which may be of either the triangular or flat type, is fastened to the head by a chuck and may be readily removed, replaced or turned around so as to bring the desired edge into use. The scale moves freely between the two stops, with spring stops at 30, 45 and 60 degrees, these being the angles most frequently used. It is thus possible for the manipulator to set his scale at these positions quickly without referring to the protractor to be sure of their accuracy. In changing the setting of the protractor, all of the stops are simultaneously revolved, and the common relations of lines may be readily established on the new base. The flat horizontal placing of the rods in the arm gives rigidity where necessary, but also allows a desirable flexibility in a direction perpendicular to the plane of the paper. The scale will, as a

consequence, lie flat on the paper, but may be raised slightly in moving from place to place, to avoid the rubbing of fresh ink lines.

The feature of the machine which is of greatest importance to its perfect working order is the tightness of the joints in the arms. After trying a number of kinds, the makers have finally adopted a hardened ground joint, which, on account of the slight pressure and speed with which it is used, will last indefinitely. The pin for the stops is made conical to compensate the wear. All parts are finished in nickel except the rods, which are coppered and oxidized.

The boards are regularly furnished 19 by 23 inches in size to accommodate sketches 18 by 20 inches, but by special order may be had in any size. The dealers will also supply for use with the machine scales of any type, size or graduation.

The principal points of difference between this machine and the larger one are the use in the latter of two scales at right angles with each other instead of one, and a hinge at the corner where the mechanism is fastened, allowing it to be swung entirely clear of the board. The head also has a hand wheel so that the moving and turning of the scales may be done with the left hand, without touching either scale. The use of two scales saves some time and inconvenience, because a horizontal or vertical line may be drawn without the swinging of the scale, which is necessary in the other machine. The smaller one, however, has the advantage of compactness and portability, rendering it valuable for field work.

The Gas Turbine.

Invention says now that the merits of the steam turbine have been fairly well recognized, engineers are turning their attention to the development of the gas turbine, and with good hopes of ultimate success. While the reciprocating gas engine operating under proper conditions is probably the most efficient machine, so far as fuel consumption is concerned, for converting the stored energy of carbon into mechanical energy, it possesses certain disadvantages which to-day deter engineers from its more general use.

One of these objections is the relatively large size of the gas engine as compared with a steam engine of equal output. The gas engine is generally single acting, and has but one explosion every two revolutions, while the steam engine is double acting, admitting steam twice every revolution. Therefore, the gas engine would have only one-fourth the capacity of a steam engine of the same dimensions if the latter worked through the same range of pressure. Since, however, the working range of pressure in the gas engine is much higher than in the steam engine, the actual performance is not so unfavorable, and the gas engines have come into extensive use where other considerations were involved in the selection.

Another disadvantage under which the reciprocating gas engine labors is the necessity of using water jackets on the cylinder to insure proper operation and sufficient lubrication, without which the life of the machine would be short. The temperature of the ignited gases is very high, so that the circulation of cooling water becomes necessary to keep the temperature of the cylinder low enough for successful operation. It has been stated that the heat carried off in the cooling water alone represents one-fifth of that delivered to the engine. In the steam engine, on the other hand, the cylinder is usually lagged with some non-conducting material to prevent, as far as possible, loss from radiation.

The third objection to the gas engine is the intermittent nature of the propelling force. In the steam engine with conditions only one-fourth as bad, the parallel operation of alternators has given considerable trouble and been the subject of much discussion of late. To meet this condition gas engines are constructed with a liberal use of metal and very heavy flywheels. This construction, of course, steadies the speed of the engine, but it is very probable that it would not aid to any extent in preventing heavy cross currents between paralleled alternators. It is generally accepted that it is desirabe to keep the inertia of the moving parts as small as possible.

The steam turbine, on the other hand, can be made to possess just the qualities that the gas engine has not—large output, light weight, uniform angular velocity, absence of danger from high temperatures and no difficulty in lubrication. Further, if it is found possible to replace the steam with gas there will be no need of using cooling jackets, and this great cause of loss will be eliminated.

Therefore, it is no wonder that certain eminent engineers have been attracted by the possibilities which the development of a satisfactory gas turbine offers.

The problem to be solved is that of producing a continuous combustion of gas under pressure and under complete control. While this appears difficult to-day, there seems to be little doubt of the ultimate success of this work, and when it has been accomplished the gain will be even greater than has been indicated above. It will mean an abandonment of one link in the chain of transformation as used to-day. The energy liberated in the furnace will be conducted at once to the prime mover, doing away with the boiler and rendering the generating station independent of the water question. It will mean that we have made one step nearer the final goal, the direct conversion of the energy of coal into electrical energy.

Canadian Niagara Power Plants.

Iron Age says it is highly probable that there is no other point in the Dominion of Canada, possibly not in the British Empire, where there is such marked industrial activity as on the Canadian side of Niagara Falls, where two companies are hurrying their work in the development of a portion of the power of the famous Horseshoe Fall, in order that a generous supply of electric current may be placed on the market for the operation of industrial establishments and for transmission to distant places. The companies creating the development are the Canadian Niagara Power Company and the Ontario Power Company. The Canadian Niagara Power Company is practically the same Company that has already developed power by means of a tunnel and wheel pits on the New York side, while the Ontario Power Company has John J. Albright, of Buffalo, for its President, and is making a development which the Company expects will be second to none in the Niagara region.

Canadian Niagara Power Company.—For the development of power on the Canadian side the Canadian Niagara Power Company has adopted methods identical with those already applied to the development on the New York side—that is, they are to develop the power by means of a wheel pit and tunnel. The work has been underway several months and it has made splendid progress. The wheel pit is down to a depth of 106 feet, and progresses in depth at the rate of about 12 feet a month. The plans calls for a pit 480 feet long, but the section now in course of construction is 266 feet in length and will provide room for five turbines and connected installation, affording a development of 50,000-horse power, the final development from the pit when fully completed to be 100,000-horse power. But it is likely that the Company will make even a larger development than this on the British side of the river, that is so bountiful in its power supply. The depth to which the wheel-pit is to be carried will be about 170 feet, and it will be about 21 feet wide. The wheel pits on the New York side are carried to a depth of about 179 feet, but on the Canadian side the land is slightly higher. In sinking the first Canadian wheel pit it is worthy of note that much the same conditions of rock have been met as on the New York side, with the exception, however, that the blue limestone is found near the surface. In sinking the New York wheel pits this rock was not found, but it crops out near Queenstown on the Canadian side 5 miles or so below.

The water discharged from the turbines to be installed in the Canadian wheel pit will be carried to the lower river through a tunnel. This tunnel will be 2,200 feet long, 25 feet high and 18 feet wide at the spring line inside the lining. Thus it will be 4 feet greater in height than the tunnel on the New York side. The contractor on the tunnel is Anthony C. Douglass, who has had much experience in driving tunnels through the Niagara rock. Midway between the wheel pit and the portal of the tunnel a shaft, 10 by 16 feet, was sunk, and this facilitated the tunnel construction. The work of removing the lower bench of the tunnel is now in progress, and it has been taken out for a distance of about 1,000 feet. The tunnel at Niagara Falls, N. Y., is lined with brick throughout, but, owing to the prevailing brick famine, the Canadian Niagara Power Company will dispense with brick to a considerable extent, and from the spring line down the Canadian tunnel will be lined with concrete, the facing, however, to be of vitrified brick. This application of concrete to this portion of the work will save using about 3,000,000 brick. The arch of the tunnel will require at least 1,250,000 brick, 200,000 of which are already in hand.

Method of Taking the Water Supply.—It will be recalled by those familiar with the conditions of the development on the New York side that the water supply is taken from the upper river through an inlet canal. On the Canadian side a vast forebay will be constructed, the contract for which is in the hands of Dawson & Riley, of St. Catharines, Ont, the same firm having the contract for sinking the Canadian wheel pit. This forebay will have a length equal to that of the wheel pit, and after spreading out in front of the pit it will narrow down to 250 feet at the point where it will be crossed by the tracks of the Niagara Falls

Park and River Railroad, when it flares out again to a width of about 400 feet. The walls will be of stone brought from the vicinity of Montreal. The forebay will carry an average depth of 18 feet of water. From a point near the north end of the wheel pit a canal 16 feet wide and running northeast for a distance of about 500 feet will be constructed as an ice run, the difference of level between the entrance and the mouth of the canal to be 4 or 5 feet, so that a good current will be created through it. It will discharge into the river below the forebay, and gates will be erected near the wheel pit end to regulate the flow.

The tracks of the Niagara Falls Park and River Railway will cross this forebay, or what may be termed the canal-like portion of it, on a magnificent stone bridge composed of 5 arches, each about 50 feet long and 60 feet wide. The bridge will also be provided with a boulevard driveway, and when finished is expected to be the finest piece of stone arch bridge construction in the country. The contractors on this bridge are Mumford & Lowery.

The plant of Dawson and Riley begins with a boiler capacity of 750-horse power. They have two compound Rand air compressors of 250-horse power each, Corliss valve type; also eight channeling machines of Sullivan make, and two gadders and eight drills of the Ingersoll type. They have in use two 10-ton Brown locomotive cranes, but until recently they have been using derricks on the work. They employ a large number of hands.

Anthony C. Douglass, who has the contract for the tunnel, shaft and portal, also employs many hands. He has two compound duplex Ingersoll air compressors, each of 125-horse power, in use. They are operated by a 400-horse power electric motor, the current being transmitted from the New York side. In addition to this his plant consists of about 12 drills, two Lidgerwood hoists, one Otis elevator hoist and a rock crusher. He will use about 20,000 barrels of Lehigh cement, and in the timber work of the tunnel he has used about 2,000,000 feet of timber. In the masonry about the portal he will use 60 carloads of granite from Quebec and 200 carloads of Queenstown limestone.

Large Units in the Power House.—In this connection it is worthy of note that the power house to be erected over the wheel pit on the Canadian side of the river will have units of 10,000-horse power, or 7,500 kw., which is double the output capacity of the units in the stations of the Niagara Falls Power Company. The generators will be wound for 12,000 volts, three phase, but in order that the machines may be paralleled with those in the stations on the New York side the frequency will be maintained at 25 cycles. In establishing 10,000-horse power as the unit for the Canadian development the Canadian Niagara Power Company effect a lower cost of generator and turbine per horse power, while the machines will take up but little more space than a machine that will generate but 5,000-horse power. The generators to be installed will be of the internal revolving field type with vertical shaft. They will make 250 revolutions per minute. The diameter of the generators will be about 19 feet, while 141,000 pounds will be the weight of the revolving part of the machine.

In the agreement between the Canadian Niagara Power Company and the Commissioners of Victoria Free Park it is provided that the developed power is to be transmitted beyond the park boundaries for use in manufacturing plants or otherwise, and for this reason it is believed that the voltage of 12,000 will result in economy for this transmission and distribution to consumers. While it is contemplated to supply Toronto, Ont., with electric power from this great installation, the voltage of the power to be sent there will be raised to something like 60,000 volts, it is understood. Under the controlling agreement the Canadian Niagara Power Company must have contracted to expend or actually expended by July 1, 1903, the sum of $1,500,000 in works, plant and material in connection with the project, while by July 1, 1904, they are to have water connections for the development of 50,000 horse power, and to have 20,000-horse power actually ready for use, transmission and supply.

Ontario Power Company.—The plan of this Company contemplates a development of power on the Canadian side very similar to that employed by the Niagara Falls Hydraulic Power and Mfg. Company on the New York side. However, as far as their plans have been made clear, it appears that the supply of water for the wheels will be conducted through one or more pipes of large size, possibly about 18 feet in diameter. This water supply will, it is indicated, be taken from a fore bay structure created in the vicinity of Dufferin Islands, the pipes running through Victoria Free Park to a point on the high bank in the vicinity of the power station. These pipes will be either of wood or steel, and will be placed underground, so as not to mar the scenic beauty of the park. It is understood that a series of penstocks will extend from them down the bank to the station and the wheels to be there installed. The excavation for the site of the power house is being pushed as fast as possible, the hope being that the Company will be able to clear the *débris* slope of the bank away before cold weather sets in. This site is not far distant from the Horseshoe Fall, and it is almost continually under the influence of the spray cloud of the cataract. For this reason it is evident that unless the winter is a very open one it will be impossible to do much on the site during the cold season, when it may be expected that vast quantities of ice will form on the site and in its vicinity. The dimensions of this station are not as yet announced. It is probable that the winter will be employed in driving tunnels through the cliff to the point of the large pipe feeders above mentioned.

In preparing for their development the Ontario Power Company have wrought a truly marvelous condition of affairs in the vicinity of the beautiful Dufferin Islands, and there is now visible there a scene which human eyes have never before witnessed. Starting from the mainland they have built a dam about 782 feet out into and down the river, and this has served to divert all the water from the island vicinity out into the deeper main channel, leaving the river bed for a vast area high and dry. It is a remarkable spectacle so created, and it may be judged that many people made anxious search over the dry rocks, in the pot holes, depressions and crevices for things that might form relics of this strange condition of affairs. It is found through this work that the river bed is of solid rock of strange formation, the rapids creating ledges all being bared to the eye. It is thus clear where the upper Niagara obtains its pretty little falls as the waters of the great lakes rush in such mighty torrent toward the world famed brink.

The construction of this big cofferdam was accomplished by Barry and Company, and it is looked upon as one of the best pieces of work of the kind done at Niagara. It runs through water having a depth of from 6 to 7 feet, while outside of it the current sweeps along at a 12-mile per hour pace. During the winter the Ontario Power Company will push the work at every possible point, and it is expected that with the opening of next spring there will be truly wonderful activity in the progress of developing the power of Niagara on the Canadian side by both of the companies having franchises there.

Influence of Electrification on the Electric Spark.

By Mr. Ernst Lecher.

So many circumstances influence the passage of electricity through gases that we cannot form a satisfactory idea of the simplest spark discharge in air in spite of many excellent investigations. The idea that at a certain electric tension the dielectric air breaks, so to speak, appears less simple on closer study than it does at first sight, as too many factors determine this "dielectric strength" or "electric elasticity." In the following I intend to discuss a new factor of this kind whose existence, as I believe, has not as yet been pointed out. I electrified the spark gap in air connected with an induction coil by means of a second source of electricity.

Experiments with the Spark of an Induction Coil.—A medium sized coil, provided with a Neef hammer, is fed by four accumulators. Let A be its secondary coil and F the spark gap. In addition, to moist rings, a and a_1, inclosed in caoutchouc tubes and 60 cm. long, are attached to the poles of the induction coil. Both of these are joined to a pole P, of a Voss influence machine of four plates. The other pole P', of the influence machine is put to earth. This brings it about that both spark electrodes, independent of the oscillation of the induction coil, can be brought to the same positive or negative difference of potential with respect to the air of the spark gap.

The charge through the moist twine probably compensates any oscillations of potential of the influence machine. Besides, the strings as a shunt of the induction coil have so great a resistance, that the spark in F hardly suffers under it. If two choking coils are substituted for the strings, the spark is too much weakened.

Experiment 1.—The two electrodes at F are drawn apart far beyond the discharging distance, and no spark can, therefore, pass.

When the coil is not working and the influence machine alone is worked, so that the whole secondary coil and the electrodes are charged with positive or negative electricity through the wet strings, very feeble points and brushes of light are seen in a dark room. On the other hand, if the influence machine is not working and only the induction coil is working, very feeble brushes of light are seen at the positive electrode and on the positive connecting wire. When the influence machine and the induction coil are worked simultaneously, the positive brushes produced by the induction coil are intensified to an astonishing extent by a positive electrification of the secondary coil. By this simultaneous action of the positive electricities furnished by the induc-

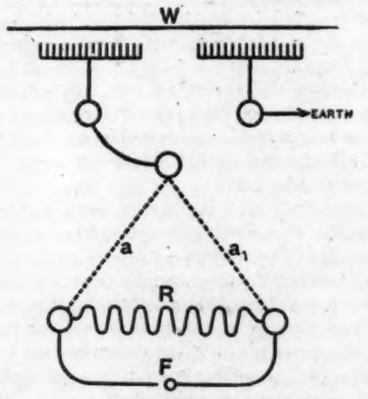


Fig. 1.

tion coil and influence machine, the total tension of the positive wire against the surrounding air is increased. Perhaps, also, the positive electricity of the influence machine furnished during the pauses in the work of the coil weakens the dielectric strength of the air for positive discharges to such an extent that the brush discharges of the induction coil can take place with greater ease. I have not yet formed an opinion as to the comparative effect of these two causes.

Experiment 2.—On the other hand, the feeble light brushes produced by the coil alone are made to disappear entirely by a negative electrification. I have put this observation at the head of my communication because I believe that the experiments to be described in the following can be most easily surveyed from this point of view.

The brush discharge usually forms an important part of the total discharge. Walter has shown this very beautifully in ordinary induction coil discharges between platinum points. In this case the spark is not produced instantaneously. Its path must be prepared by some brush discharges which precede it and follow each other at intervals. These preparatory discharges are first seen in connection with the positive pole. The spectrum of these brush discharges does not contain any metal, and no trace of the material of the electrode can be discovered chemically in the discharge. Such brush discharges are electric processes in gases, which must occur near the positive electrode with a continually increasing magnitude, before a discharge passes over the whole spark-gap

If, therefore, the positive or negative electrification is capable of influencing these brush discharges which prepare the path of the spark, then the discharge itself must be modified by electrification. The most striking results may, therefore, always be expected whenever the positive portion with its brush discharge is greatly favored by the arrangement of the experiment. That is why I chose, after Cook, a spherical cathode and a moderately blunt anode.

Experiment 3.—In Fig. 2 the two electrodes are shown in natural

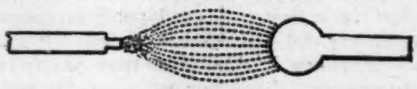


Fig. 2.

size. The electrode *e* is the anode for the discharge from the induction coil, and the sphere *f* is the cathode. Let the distance be such that no spark crosses, say, 4½ cm. to 5 cm. If the induction coil alone is worked, brushes proceed from *e*. In *f* there is only a point of light, and the whole space between is dark, as also are the wires leading to *e* and *f*. As soon as positive electrification arrives from the influence machine, the following changes take place: The wire leading to *e* is covered with brushes shooting out in all directions, while next to nothing is to be seen on the cathode wire. Between *e* and *f* strong sparks suddenly cross, and it appears as if in the first moment before the zig-zag shaped sparks set in, the discharge of *e* is bent momentarily outward. If the supply of positive electricity is cut off, then the former initial condition sets in again.

This experiment also succeeds in the reverse order. Let the induction coil stand still and the influence machine alone work. From the anode *e* there only proceeds a small brush, and other small brushes spring from points of the conducting wires. If now the induction coil begins to work the sparks between *e* and *f* suddenly set in, and numerous sparks are seen along the anode wires, while those at the cathode disappear.

Experiment 4.—Let the intensity of the primary current of the induction coil be such that between *e* and *f*, a distance of about 3½ cm., a strong spark just crosses, then nothing is seen on the electrode wires. But as soon as negative electricity is supplied from the influence machine, the spark is at once extinguished, and only a feeble luminosity of the negative electrode wire is seen.

The experiments 3 and 4 also succeed very nicely when the cathode is connected with the inner coating of a small Leyden jar whose outer coating is earthed. Both experiments may be varied in many ways, but I limit myself to giving the most important typical cases.

Experiment 5.—The effects observed were also seen when the sparkless gap was surrounded by a glass cylinder, which made a change of the retardation of the spark by ultra-violet radiation from outside impossible. But in this case the primary current and the spark gap were much smaller than in the last case, in order to reduce the effect of the glass wall. A frequent repetition of this experiment should be avoided, since the glass wall becomes charged.

Experiment 6.—Up to the present we have favored the production of the positive brush by the form of the electrode, but if this favoring of the positive part of the discharge is exaggerated, as by choosing for a cathode a semi-conductor such as a slate (after Toepler), the positive brushes of the induction coil discharge become so strong that my method of electrifying a spark gap by means of an influence machine loses some of its effect. For the same reason the phenomena also ceased when the currents from a coil of the Kohl pattern, with a 40 cm. spark gap, became too strong. A further complication is introduced by the fact that electrification by means of an influence machine also favors or hinders the formation of brushes along the electrode wires. This changes the insulation of the wires of the secondary circuit with respect to the air from one case to another. A careful covering of the wires with glass tubes and of the exposed binding screws with gutta-percha covers improves experiments 3 and 4. But this source of errors cannot be completely avoided; and it explains the following results:

Experiments 7 and 8.—If the blunt point *e* is made a cathode, and the sphere *f* an anode, the favoring of the spark by positive electricity and a hindering by negative electricity is still noticed. But the phenomena are less striking than in 3 and 4, and sometimes they give out when the spark is positively electrified. For the brushes appearing on the wire leading to the anode are here specially intense, and this short circuit, with a possible back discharge through the coil, weakens the effect.

On the other hand, a negative electrification neutralizes all short circuits produced by dissipation into air, and the weakening of the spark is less marked, since the better conduction partly compensates the diminution of the spark by the negative electricity.

Experiment 9.—If an induction coil spark crosses between two spheres 1 cm. in diameter, both positive and negative electrification intensifies the spark. In this case there are probably some electrical oscillations which interfere with a one-sided discharge.

Experiments with a Spark from a Wehnelt Interrupter.—The current from 30 accumulators was conducted through a resistance box and a Wehnelt interrupter into a small transformer. The junction of the secondary coil with the electrodes *e* and *f*, and with the moist strings *aa*, was arranged exactly as in Fig. 1.

Experiment 10.—This corresponds to Experiment 1. The pointed anode *e* and the spherical cathode *f* were about 2.5 cm. apart. At first the influence machine was at rest, and the primary current was so adjusted by means of the resistance box that in the dark the following discharge was seen: At the anode *e* there are about four stalks of light, ½ cm. long and branching out. The middle space is feebly blue, and on the right at the surface of the sphere there are about 10 luminous points without stalks. Sometimes, at intervals of about 10 seconds, feeble sparks shine out. A mechanical blowing against the spark gap hardly changes the phenomenon. If now the influence machine also is set to work and supplies the secondary coil and the spark gap with positive electricity, the anode wire is full of brushes; in the electrode space itself the brush stalks to the left become much longer, the brushes widen out like funnels, the diameter of the blue light becomes larger, and the shape of the whole discharge becomes spherical instead of oval.

I now describe a remarkable phenomenon. If a pencil point held in the hand or any other point connected to earth is approached to the spark gap of within about 25 cm., the spark gap suddenly becomes dark, and at the pencil point itself there appears a small and very feeble point of light. If a second point is approached from the other side, the appearance hardly changes, so that we can scarcely talk about the effect of an electrical wind in the ordinary sense, especially as a mechanical blowing produces no change. If a glass plate or a metal plate is placed between the pencil and the spark gap the effect disappears. It is not produced by approaching the finger or an earthed sphere within 10 cm.

It also seems worth mentioning that in approaching the point to the

electrode wires only those brushes which face the point disappear, while the phenomenon between *e* and *f* remain the same. We, therefore, have to do here, not with an effect upon the total potential of the secondary coil, but only with a purely local effect. It appears to me improbable that the ultra-violet radiation of the point of light attached to the pencil point could be the cause of the phenomenon, since the active space proceeding from the point is too definite, and has the form of a cone, such as has been repeatedly found to be associated with the effect of a point. Whether the pencil point is above or below or beside the spark gap is indifferent, as long as it is directed towards it. If the point is approached to within 2 cm. a part of the discharge is deflected into the point.

Experiment 11.—If *e* and *f* are a little less far apart, and only the interrupter is working, the phenomenon shown in Fig. 2 becomes stronger, but only remains visible in the dark. Now, an addition of positive electrifications suddenly makes a strong spark pass, which, of course, is also seen in daylight. This spark is extinguished by approaching an earthed point to it. This experiment seems to me to succeed particularly well with a blunt carbon point as an anode at *e*, although otherwise the electrode material seems to be without influence. We may, therefore, say that an addition of positive electrification lights up the spark, whereas the approach of an earth point extinguishes it.

These experiments are very prompt and certain. The effect of the point is capricious only in so far as I sometimes had to approach the spark-gap to within 20 cm., and at other times obtained good effects even at a distance of 45 cm.

Experiment 12, *the reverse of* 10.—The form of discharge shown in Fig. 2 is extinguished when negative electricity is brought up through aa_1, while the approach of an earthed point re-establishes the old phenomenon.

Experiment 13, *the reverse of* 11.—The electrodes are approached within 1.5 cm., and a bright spark crosses, the interrupter alone being at work. Negative electrification extinguishes the spark, while the approach of an earthed point lights it up. Here also the earthed point only acts against the spark-gap, but not against the conducting wires, even at quite short distances.

These results are very certain and easy to obtain, but both in the induction coil discharges and in the Wehnelt sparks the results become somewhat less reliable, when the blunt point is made the cathode and the sphere the anode.

Experiment 14.—Let *e* be the cathode and *f* be the anode for the Wehnelt discharge, then the result of the positive electrification is very uncertain, but I rather believe in a diminution than in an increase of the spark. With a distance between the electrodes of 1.8 cm. a flame shaped arc curving upwards is obtained without electrification. With positive electrification, the arc is changed into a straight white spark.

An earthed point must be brought to within a distance of about 10 cm., and then the electric spark appears blown apart into a row of red arcs.

Experiment 15.—The addition of negative electricity extinguishes or weakens the spark. If, for instance, a non-electrified spark cannot be blown out, this is easily effected when the spark is negatively electrified.

If an earthed point is brought to within 10 cm., a curved reddish Wehnelt flame is converted into a straight whitish spark of feeble intensity. It looks as if the approach of the point extinguished the halo. Experiments with spherical electrodes give similar results.

With much stronger Wehnelt currents the influence of electrification is also present, but seems to be of an entirely different nature. It looks as if the electricity were blown out of the arc. Since the surrounding conductors do not lie symmetrically, the effect resembles the phenomenon produced by mechanical blowing.

Conclusions.—All the experiments described make it appear certain that the electrification of a spark gap which changes the potential difference of the different electrodes with respect to the dielectric has a decided influence upon the luminous phenomena.

Unfortunately the arrangement shown in Fig. 1 does not allow of the induction coil being directly replaced by an influence machine. Since, in consequence of the short circuit through the wet strings no spark is generated, it would be necessary to use two influence machines of the same construction in series for generating the spark, and the electrification would have to be brought from a big machine to the junction of the two smaller influence machines. Only with such an arrangement quantitative results with respect to the potentials and quantities of discharge actually obtained could be carried out.

The whole series of phenomena seems to have much similarity with the effect of magnetic forces upon discharges, as described by Precht. Perhaps the explanation lies in the fact that electrification expels one species of ions from the discharge space.

The Education of Engineers.

[By Mr. Jno. R. Hewett, in *Engineering*.]

So much has been written recently concerning the education of engineers, and so much interest has been displayed in the subject, that perhaps a short addition by one still in his student days may not be deemed out of place.

The writer has already served a 3 years' apprenticeship in the works of a mechanical engineer, and is now in his third year at a technical institution as an electrical student.

1. The object of this article is to chronicle some of the difficulties experienced during that period, and to discuss, as far as it is useful, the different courses open to a student during both his training in the workshops and the time that he is pursuing theoretical studies.

The student who has just left school is on the high road of life—a road which has many turnings, and so much that affects his after-career depends upon which turning he chooses, the right or the wrong. If a false step it made at this early stage it will take a long time to realize it, and still longer to retrace his steps and start afresh. Indeed, it is often an impossible task.

2. No hard-and-fast rule can be laid down to solve the first difficulty he will meet with—as to whether it is better for him to enter works and "serve his time" immediately after having left school, or to go directly to a technical college or institution. As a matter of fact, so much depends upon the character of the individual that unless this is known to the person from whom advice is sought, a disastrous beginning may often be the result. The course that is eminently suitable for one may be the ruin of another. The lad who, during his training at school, has shown no inclination for work, will treat his college course as merely an extension of his school days, and in so doing will waste—to a greater or lesser extent—some of the most valuable years of his life, which can never be recalled. More often than not this type of boy, if he finds himself placed in engineering works, will realize more fully the earnestness of life, and it will be brought pretty forcibly to his notice that he cannot expect ever to be an engineer without taking off his coat and putting his shoulder to the wheel.

There are, again, many who, though intending to become engineers, think too much of personal appearance and dress. These affectations may often be nourished to a dangerous extent at a technical college, whereas, the experience of the workshops, and the association with the workmen on terms of almost equality, will go a long way towards showing a student of this temperament that there are more useful things to be thought of than cuffs and collars if he is to become a successful engineer.

3. On the other hand, the student who has been to a technical college first will be far more useful in the workshop and drawing-office, and consequently will be preferred to those who know little or nothing of the principles underlying the works that they are performing. Such a student will often gain valuable experience by being put on a higher class of work, and by being sent out in charge of an "out job."

Fortunately there are many whose ultimate success would not be materially affected whichever course they chose; for the earnest student who is sincere in his work, and at the same time blessed with ability, will overcome any obstacle which he may meet.

The student who takes his workshop course first will have the advantage of having his theory at his finger ends at the time when he requires it most; whereas, those who go first to the technical college will in all probability forget a great deal that they have learnt there during their term of service in the works.

For argument's sake, let us follow the course of a student who determines to enter the works immediately after leaving school.

4. The selection of suitable works is, indeed, a complex problem, and one which can only be solved by one who really knows good works from bad. On this point a student needs sound advice. There are works at the present time which derive a large percentage of their profits from premiumed pupils, at the same time doing a class of work from which little useful experience can be gained, although they may issue glowing pamphlets of the work they execute, and the advantages to be derived from becoming a pupil at their establishments. As often as not, these firms agree to pay the whole of the premium back in wages during the term of pupilage—of such firms beware!

There is one course which can, I think, be recommended without fear of contradiction, and that is—serve your apprenticeship in *small* works, for there is little doubt that the pupil will learn more in small than in large works. In large works, in almost all cases, a pupil or apprentice goes through only a few of the many departments; he becomes only a very small unit among a very great number of workers, and in con-

sequence little notice is taken of his progress, and still less interest. He will be put on one class of work, and when he has got into the way of performing that with any degree of proficiency, he will be too useful to his employers for them to willingly give him a shift to other work on which he would have to start afresh. The consequence is that when his term of service is over he has gained but a limited experience.

On the other hand, in small works, where fewer hands are employed, a student will have a greater interest taken in his progress, and he will have a constant change of work, on which depends so greatly the amount of knowledge he will accumulate during his time in the works.

Another advantage difficult to over estimate is that in small works he will see some engine or piece of machinery constructed from start to finish, all under his own notice. One part in this machine, another in that, the whole process is performed within his range of observation, from the forge and foundry till the machine is erected and complete in every detail. This is an advantage which is impossible in large works, where every separate part is completed in its own department.

The question is often asked as to what type of work is most useful for a general knowledge of engineering. This is again a difficult question; but on one point there is little doubt. Whether the student is ultimately to become an electrical or a mechanical engineer, the foundation on which he should build is a thorough knowledge of *mechanical* engineering; for surely an electrical engineer must have a thorough knowledge of the older science to enable him to cope with the many problems he is sure to meet with sooner or later in his profession, and which are really based on mechanics.

After works have been selected, the next point to be decided is whether he is to spend the time in them as an apprentice or as a pupil, and how long he is to serve in either case. There can be little doubt concerning the former question. An apprentice will learn far more than a pupil—at least, more than any pupil the writer has met, and he has known a great number. A pupil may start well; he may come into the works at 6 o'clock in the morning (for the first few days); he may make resolutions always to do so, but how soon those resolutions go to build up that great pile of paving stones with which, we are told the road to a certain place is laid, is only too well known to many a works manager, and—to a far more bitter extent—to many a pupil. The advice of a kind friend to me, when I asked this question, was to go as an apprentice and work. I am glad to say that I took that advice, and have never regretted it. The temptations to "slack," after the novelty of being in works has worn off, are many, and the best way for all those who are earnest in their desire to learn is to be bound by deeds of apprenticeship.

The question of how long an apprenticeship should last is still unanswered. The apprentice of days gone by was bound to his master for 7 years. Needless to say, that time would be excessive in the present. The times have changed. There is much more to be learned now in engineering than in those days, when all that was required of the average student was a thorough knowledge of practical work. Modern engineering is a highly scientific profession, and for this reason it is imperative for all those who are to become engineers worthy of the name, that they should acquire a knowledge of things that cannot be taught by practical work alone. Therefore, the apprenticeship is shortened, and the time thus gained devoted to studies at a technical college. The usual term of apprenticeship now is either 3 or 4 years, more often the former, experience having taught that this is long enough, if the time is properly spent, and not wasted. Often 6 or 9 months of this time is spent in the drawing office.

The experience gained, even in so short a period, in the drawing office is a most useful adjunct to a student's knowledge, teaching him not only much that is useful concerning the design of machinery and the preparation of drawings, prints, etc., but also showing that which will be useful to study more fully when taking his course at the college.

Here is one useful point that should always be remembered by a student while serving his apprenticeship—he will have to learn almost entirely through his own initiative, and the progress he makes is directly proportional to the energy he puts into his work. The advice once given to the writer by an old foreman is worthy of quotation. He may have murdered the King's English in giving it, but that does not diminish its value: "Halways watch what hother people hare doing; you learns more by hobservation than by hexplanation."

5. After a student has "finished his time" in the works, he is in a truly unfortunate position if he intends to go through a theoretical training, and has no friends in a position to know good from inferior, to help him choose a suitable college or institution. The future career of a student at this stage of his training may well be said to be in the balance of Fate, the balance dipping for better or for worse according to his choice.

There are excellent institutions where any student really earnest in his work will receive every help in his studies. As a rule, such an institution will require every candidate to pass an entrance examination in English and mathematics, and those who fail to gain sufficient marks will not be admitted. It is, however, a usual rule to make a generous allowance for applicants who have passed one or more years in works since leaving school.

For the most part, the fees of an institution which will not take everyone who applies for admission, irrespective of his attainments, are exceeding moderate, in some cases as low as $75 a year. It is a grievous mistake to suppose that the higher the fees paid the better the education. The institution with moderate fees and hard entrance examination is a befitting place for the earnest student. In such institutions each student will cost the establishment considerably more than he pays in fees, and for this reason they are not induced to keep anyone who will not benefit by the training, and do credit to it; in fact, it must be considered as a sort of scholarship. This being the case, a student, once being admitted, is by no means sure of staying there for his complete course. If he is not willing or capable of deriving the full benefit of the instruction given (which will be evidenced not only by his answers in the term and sessional examinations, but also by the quality of his laboratory and lecture notebooks, drawings, etc.), his place will be filled by another.

On the other hand, there are institutions, etc., that are both bad and dear. There are some in which the entrance examinations are a mere farce, and where glowing reports of the students' progress are periodically sent home, irrespective of their work or ability. In such institutions as these, the main object is to get as many students as possible, keep them as long as they can, and get as much profit out of them as they are able to.

I have met more than one unfortunate pupil who had been to such a place. A common boast among them is that they only use the institution as a sort of club—a handy sort of place to drop into in wet weather, or when there was nothing else to do. Such a place must be shunned by the genuine student as one would shun a plague.

A common difficulty among students after having entered a technical college, no matter whether they go straight from school or have served their apprenticeship first, is to find their mathematics terribly wanting. There are certainly many fortunate ones who, having been to a good school where mathematics are well taught, have received a thorough grounding; but the greater percentage are not so fortunate.

The system in vogue at the majority of technical colleges is to divide the students up into different sets for mathematics, according to the ability they have displayed at the entrance examination. Perhaps they are divided up into four such sets, from A to D; the most efficient students being placed in set A, the most backward in set D. In many cases all four sets are lectured to at the same time by different professors or demonstrators, the most able mathematician taking set A, the least experienced lecturing to set D. Accordingly, the most backward student has the poorest chance of improving his mathematics; whereas, if the classes were lectured to at different hours, or even on different days, the more backward students could be given the benefit of being lectured to by an abler man. We know that mathematics is a hard subject for the average student to learn; we also know that it is a still harder subject to teach; but the absolute incapacity to teach of those who are too often deputed to lecture to the lower sets of students is only known to those unfortunates who have had the bitter experience of listening to them. Mathematics holds to modern engineering much the same relation that the soul does to the human body—one is impossible without the other. Over and above this, a deficiency in mathematical training not only partially or totally incapacitates the individual for his duties, but affects very materially the progress and enterprise of a nation that is contending in a great commercial struggle.

6. If this is true, and the seriousness of the situation is recognized, surely there are few who would point out the extra trouble and labor that would be involved by altering the existing time tables, or the extra work that would be thrown on the shoulders of the lecturer who is able to teach in an intelligent manner. And if these alterations are not made, surely the governors of the college should employ specially trained and sympathetic men to teach the lower classes. It is far from my intention to be as the dog that bites the hand that feeds it; I do not say that those who lecture to the lower classes are unwilling to help, but that they are often incapable is a fact which is impossible to deny.

As in most parallel cases, there is a reason for such a state of things existing. The remuneration that a junior demonstrator receives for his

services is far below that which should be received by a man capable of performing the duties expected of him.

The natural outcome is that these posts are looked on only as stepping stones to something better; and consequently, directly a man has learned to teach, he leaves for a more remunerative occupation, and a new one steps in to learn at the expense of the poor unfortunate students. The only course open to a backward student is to take private lessons in mathematics, and there are many who cannot afford it, and who are therefore handicapped in all their studies.

Fortunately, this state of affairs does not exist in all branches of college work. The lectures in mechanics, electricity and physics, etc., are taken by those holding the better paid and more responsible positions of professors, and how excellent these lectures are, in almost all cases, is readily testified by the students themselves, as well as by the results obtained.

The tutorial classes are often too large to permit of anything like individual attention, but if mathematics received the care due to so important a subject, the difficulty would be, to a great extent, removed, as it is always found that the most potent stumbling-blocks arise from an insufficient knowledge of that subject, which is supposed to have been taught in another class.

The importance of the *laboratory* work should never be lost sight of by the student, as it is the experience that he gains through this medium that keeps his knowledge from becoming a mere book knowledge, which is in all respects inferior to a practical insight. Indeed, a knowledge gained by books alone, and never turned to practical account, is too often misleading, and gives but an inadequate idea of the principles involved in a mere equation. Although equations learnt from the text book may be true, there are a hundred and one practical details which are not included, yet which enter into and seriously affect the results obtained. These can only be understood and digested by the individual performance of the actual experiment.

A very great deal might be written concerning the difficulties that a student will have to contend with after having completed his training, as far as the workshops and technical colleges are concerned; but these considerations are beyond the sphere of this article. Of one thing, however, all students may rest assured—that every hour conscientiously spent in diligent study will lessen the difficulties of the future, and make smoother the paths that lead to success.

Overhead Wires and Storms.

Reference was recently made in *Cassier's Magazine* to the severe losses that telegraph, telephone, and electric light and power companies have to undergo on the occasion of severe sleet storms by reason of damage and sometimes disaster to their overhead wires. It has, heretofore, been considered advisable to shorten the span between poles as much as practicable in order to lessen the load upon individual poles, so that it has not been uncommon to have 30, 40 or 50 poles to the mile.

While this practice is warranted in some respects, it also has its disadvantages, among which are greaater first cost, as well as the subsequent greater cost of maintenance. For example, taking a 30-wire telegraph line, the difference in amount of material between a 35 and a 50-pole per mile line is, insulators and tie-wires, 525 per mile; cross-arms, 75 per mile. In a 300-mile pole line this would amount to 175,000 insulators, the same number of tie-wires, and 23,500 cross-arms in favor of the 35-pole per mile line. As each tie-wire is about 18 inches long, this is equal to about 45 miles of wire.

The foregoing takes no account of the additional cost of labor in the construction work. Unfortunately, also, when a disastrous storm comes, it is not uncommon for one pole after another to fall, like bricks in a row, for hundreds of yards, showing that even the highest number of poles now used is not a certain preventive of such collapses. There is also an electrical objection to the multiplication of poles, namely, the lowering of the total insulation resistance of the line thereby, especially in wet weather.

It is, therefore, not astonishing to learn that some of the long distance power transmission companies are seriously considering a radical departure from the conventional practice, proposing to dispense with poles altogether, and in their place to erect large towers, 60 feet high and 1,000 feet apart, on which they would string their heavy conductors 9 feet apart. Assuming that this plan will be found feasible, it is reasonable to assume that the cost of, say, five such towers per mile will not much exceed that of the 40 or 50 poles per mile line.

With proper precautions the life of such towers should be very long, and the cost of maintenance comparatively low. This proposed departure would not be altogether an experiment, for it was frequently necessary in the early days of telegraphy, and before the advent of submarine cables, to employ long spans of wire to cross rivers and bays. For example, there were several spans of wire over 2,000 feet long across the Elba and other rivers in Continental Europe, and prior to 1847 the Hudson river, in the United States, was spanned by a number of wires from Fort Lee to Washington Heights, which was then 10 miles out of New York city, but is now several miles within the city limits. At that point the river is 2,700 feet wide, and it was the custom to lower the wires into the water to permit ships to pass, for which purpose men were stationed at the crossing. The Mississippi river also was spanned in this way in several places, and at one point where the river was 3,720 feet wide, the wires, No. 16 hard-drawn iron, were supported on masts 307 feet in height.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

Superintendent Knowles reports that the maximum sendout for 24 hours in the history of the Richmond (Va.) gas works occurred on the 18th ult., when the station meters registered the passing of 1,221,330 cubic feet. The prior record was made December 24, 1901, when the registration amounted to 1,203,500 cubic feet. Hurry on with the construction of that new storage holder, Messrs. Councilmen.

The purchase of part of the plot known as Trustees' Garden adjoining the works of the Mutual Gas Light Company, of Savannah, Ga., gives substantiality to the rumor that much money will be expended in gas plant enlargements in Savannah next year.

In the matter of the petition of the authorities of Chicopee, Mass., to the Board of Gas and Electric Light Commissioners, for a decree reducing the selling rates charged by the Chicopee Gas Light Company, the Board, after a proper hearing and due consideration thereof, has rendered the following decision: "This was an application by the Mayor of Chicopee, pursuant to a vote of the City Council, for a reduction in the price of gas supplied by the Chicopee Gas Light Company. The Chicopee Gas Light Company was organized in December, 1896, and purchased the property and business of the Chicopee Gas Company and the gas business of the Chicopee Falls Manufacturing Company. It immediately combined the business of the two and made substantial expenditures to increase its facilities for supplying the city. The Chicopee Gas Company, organized in November, 1895, was formed by the Dwight Manufacturing Company and the Ames Sword Company, two important local concerns that had for several years owned and operated a gas works, primarily for their own purposes, and incidentally to a limited extent, for public use. These two Companies continued to own the stock of the Gas Company and to conduct it substantially as before the incorporation up to the time of its transfer to the Chicopee Gas Light Company, in which these two concerns have now no financial interest. Apparently, the business of the present Company has not yet met the expectations of its promoters. It has a widely varying scale of prices for its gas. About 24 per cent. of its output is sold to small consumers at the net price of $1.75. For gas stoves through separate meters it sells at $1.50. About 30 per cent. of its output is used at this price. A much smaller amount is sold to certain moderately large consumers at $1.50 and $1.40, according to their consumption, and a certain amount is sold for power purposes only, at $1.25. The Dwight and Ames Companies, who were the original owners of the business, pay $1 per 1,000, and at this rate consume about 24 per cent of the entire output. This price is the result of a contract between the companies imposed by the Dwight and Ames corporations as a condition of the sale of the property, and is supposed to bear some fair relation to the price at which these companies had been able to supply themselves or might supply themselves from independent works. It is obvious that such concessions to the Dwight and other companies by relieving them from a fair share of the fixed charges tend to impose an unfair burden upon stockholders or consumers. A special rate of this character for so large a portion of the Company's output can only be justified upon the ground that it contributes to the general public advantage. If it does not, the responsibility for its existence rests with the management, and any unfortunate results must be borne by the Company rather than by the public. The Company pays no dividends, and upon the face of the accounts its profits justify none. Apparently, then, it can afford no reduction in price. These facts are not easy to understand. From the Company's

condition, its facilities and the volume of its business, it would seem that it ought to be more profitable than apparently it is, even though a portion of its product were sold at a somewhat lower price. The Board has, therefore, endeavored to make a careful scrutiny of the Company's affairs, as revealed by its accounts and the statements of its representatives. This inquiry has disclosed the fact that while the Company is in other respects able to make and distribute gas at a reasonably low cost, the expense of its management is unusually high, and burdensome alike to the Company and its consumers. By the application to this part of the business of the same economies that are applied to its other operations, the Company could readily afford some reduction in its price. The proposition that a Company is entitled to a fair profit involves a further proposition that its affairs are economically and judiciously managed. The management may, if it desires, choose between profits and a high operating account, but it cannot rightly choose to impose both upon the consumer. Some of the prices now charged are unusually low, too low, it may be, for the interest of the corporation; but the highest price charged is unusually high, and the economies demanded of the Company may properly be applied to a reduction in this price. The Board, therefore, recommends that, on and after the 1st day of January next, the net price charged for gas by the Chicopee Gas Light Company shall not exceed $1.50 per 1,000 feet. For the Board, FORREST E. BARKER, Chairman."

MR. F. N. DRANE is the active man in the works' direction of the Corsicana (Tex.) Gas and Electric Company.

A CORRESPONDENT forwards the following, under date of the 2d inst.: "The new coal gas plant of the Peoples Gas Light Company, of Rutland, Vt., has now been in operation a little over one month, although the entire plant may not be considered as completed until the old water gas apparatus is remodelled and installed in the new works. When the task is completed there will be no more modern or up-to date plant of its size in the country. The works were constructed on a site directly on the lines of the Rutland and the Delaware and Hudson Railroads, which means the direct reception and delivery of supplies 'alongside.' When the water gas apparatus is installed the plant will be equal to putting out 250,000 cubic feet daily. The apparatus includes tower scrubbers, tubular condensers, and baffle-plate ammonia washers, with the regulation centerseal system of purifier boxes, the capacity of all being fully equal to the maximum make, and connections were placed so as to permit at any time of doubling the same. The holders (2 in number) are single-lift, with provision for adding another lift to the storage holder. The capacity of the latter is 60,000 cubic feet, and the capacity of the relief holder is 15,000 cubic feet. New ownership and management are responsible for the improved condition of the concern, and the management is wideawake and untiring in the effort to increase the old trading and take on new business. About 8 miles of 4, 6 and 10-inch mains have been laid and about 250 services connected. About 350 ranges and heaters were placed during the summer and fall months, and the average increase in gas sent out for the past 3 months figures at 152 per cent., the comparisons being made with the corresponding months of last year. The average increase in receipts for the same 3 months, as compared on the basis above noted, was 76 per cent., while the price of gas was reduced from $2.25 per 1,000 to $1.44 per 1,000 net. The Company is now in position, with its new works and extended street main system, to make and sell gas at a figure at which all can use it. Some additional mains will be laid next year, but even now the city can be said to be well piped. The works were planned and constructed by Mr. A. E. Forstall, of your city. Mr. Roger W. Polk was retained by Mr. Forstall to superintend the actual construction of the plant, and on its completion the proprietors of the Company appointed him Resident Superintendent. The officers of the Company are: President, Le Roy W. Baldwin; Vice-President, P. M. Mowrey; Secretary and Treasurer, C. H. West; Directors, the officers and Messrs. W. H. Baldwin, H. R. Kingsley and Ezra A. Tuttle."

THE United Gas Improvement Company has secured control of the plant and franchises of the Haverford (Pa.) Electric Light Company, which concern has been furnishing electric currents to the residents of Wynnewood, Ardmore, Haverford, Bryn Mawr, Rosemont and Villa Nova.

THE Mount Holly works of the South Jersey Gas, Electric and Traction Company have been shut down.

THE offices of the Manistee (Mich.) Gas and Electric Company have been removed to suitable rooms in the premises, 320 River street.

THE gas and electric lighting interests of Centralia, Ills,, have been merged. The title of the succeeding corporation is that of the Centralia Gas and Electric Company, capitalized in $150,000.

MR. HENRY C. REW, of Chicago, has agreed to construct and equip, on a site to be furnished by the authorities, a young peoples' gymnasium and institute at Newark, N. Y. The expenditure on such account will certainly be not less than $15,000. In 1900 Mr. Rew built and gave to the people of Newark a handsome public library structure, the cost of which was $20,000, as a memorial to his parents. He will be best remembered by gas men as the inventor of the Rew process of gas making.

J. FRANK ALLEE is President of the Bay State Gas Company, of Delaware, Vice, J. Edward Addicks.

THE Massachusetts Board of Gas and Electric Light Commissioners has authorized the New Bedford Gas and Edison Light Company to issue 2,000 additional shares of capital stock, which must be sold at a minimum price of $110 per share. The proceeds are to pay for the works' reconstruction now underway. The Company petitioned for the right to issue 2,500 shares.

A SITE for the proposed gas works at Ocean City, N. J., has been secured. It is located at the junction of 11th street and West avenue.

THE Binghamton (N. Y.) Gas Company has purchased a site on Chenango street whereon it proposes to construct a modern office building.

THE rumor is again current that the Brooklyn Union Gas Company, of Brooklyn, N. Y., is getting ready to absorb the Kings County Electric Light and Power Company.

ADVICES from Frankfort, Ky., are to the effect that, on the 26th ult., the Kentucky Court of Appeals, the entire Court sitting, Judge Paynter writing the opinion, affirmed the judgment of the Jefferson Circuit Court in the case of the Kentucky Heating Company vs. Louisville Gas Company. This is the second appeal. The Court here held on first appeal that the Kentucky Company could not sell artificial gas alone or mixed with natural gas for the purpose of illuminating without violating the exclusive privilege of the Louisville Gas Company. The Court now rules: "If the Kentucky Heating Company has not the right to sell artificial or mixed gas for the purpose of illumination in Louisville, then it certainly cannot acquire the right to do so by the invention of a mechanical device or contrivance which facilitates its sale for purposes of illumination. It follows that the Court did not err in enjoining the sale of such gas in connection with what is known as the Welsbach burner or any other device by which illumination is produced. The Court says this gas cannot be produced outside the city and brought into the city to be sold by the Heating Company."

AT the annual meeting of the Suffern (N. Y.) Gas Company it was ordered that from the 1st inst., all consumers who pay their bills on or before the 10th of the month shall be granted a rebate of 10 cents per 1,000 cubic feet. The Directors elected were: D. W. La Fetra, P. V. Hewlett, Edward Oakes, Samuel H. Pennington, Albert C. Pedrick, Edgar Tilton, S. F. Hayward and Wm. Fairchild.

IT is not likely that the gas and electric lighting interests of Chicago will be merged, although the negotiations looking thereto are not yet at an end.

AT the annual meeting of the shareholders in the Lancaster (Pa.) Gas Light and Fuel Company the reports for the year came in for much discussion, at the close of which it was decided to recommend to the Board of Directors that the net earnings of the year should be placed in a surplus fund for the purpose of erecting additional equipment and bettering the service of the Company, and for these reasons it was deemed inexpedient to declare a dividend. The following Board of Directors was elected for the ensuing year: William B. Given, Samuel R. Shipley, Philip B. Shaw, William W. Griest and C. Edgar Titzel. It has been learned that extensive improvements are contemplated in the erection of new machinery, new holders and the extension of mains to all parts of the city.

THE difficulties encountered over the adjustment of the uew contract for a supply of coal from the Dominion Coal and Gas Company to the New England Coke and Gas Company have been surmounted. We believe a slight increase in price was agreed upon.

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

THOS. J. CUNNINGHAM,
ELBERT P. CALLENDER,
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Notification Respecting Advertising.—Orders for new advertising, or for changes in standing advertisements, to insure attention in the issue following their reception, must be in hand any time of Wednesday.

AGENTS:
New York—American News Co. 39 and 41 Chambers St.
Germany—Lemcke & Buechner, of New York.
England—Aug. Siegle, 30 Lime Street, London.

MONDAY, DECEMBER 8, 1902.

The Market for Gas Securities.

Unevenness was the characterizing feature of the city gas share market last week. The trading was light and the general trend was toward lower prices. Consolidated closed today (Friday) at 211 to 211¼. The demands made by the consumers on the Company have so far this fall and winter been of a most extraordinary sort, and its engineering staff has often wondered when a halt is to be called. However, so far the demands have been well met. New Amsterdam 5's were dealt in at advancing figures.

Brooklyn Union is nominally 220 to 230, but actual sales were few. The talk of a union of the gas and electric lighting interests of Brooklyn is again heard; but those on the inside of the gas division of the trading say that the suggested amalgamation is chiefly in the mind and wish of the electrical suppliers, Peoples, of Chicago, is steady. The idea that in Chicago the gas and electric lighting were close to merging is not borne out by the actual attitude of the controllers of the Peoples Company. Washington (D. C.) gas is down several points, and Buffalo (N. Y.) gas is quoted at 7½ to 10. Lacledes show no change.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

DECEMBER 8.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$73,177,000	100	211	211¼
Central Union, Bonds, 5's.	3,000,000	1,000	110	112
Equitable Bonds, 6's	1,000,000	1,000	105	
" 1st Con. 5's	2,300,000	1,000	118	120
Metropolitan Bonds	658,000		108	112
Mutual	3,500,000	100	350	..
Municipal Bonds	750,000			..
New Amsterdam Gas Co.				
Bonds, 5's	11,000,000	1,000	112½	113
Northern Union, Bonds, 5's.	1,250,000	1,000	108	110
New York and East River				
Bonds 1st 5's	3,500,000	1,000	112	113
" 1st Con. 5's	1,500,000		109	111
Standard	5,000,000	100	130	140
Preferred	5,000,000	100	150	160
Bonds, 1st Mortgage, 5's	1,500,000	1,000	115½	118
Yonkers	299,650	500	130	
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	220	230
" " Bonds (5's)	15 000,000	1,000	119	119½
Bay State	50,000,000	50	1¼	1⅜
" Income Bonds	2,000,000	1,000	.	75
Binghamton Gas Works	450,000	100	28	30
" 1st Mtg. 5's	509,000	1,000	93	96
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	7½	10
" " Bonds, 5's	5,250,000	1,000	75	77
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150.000	1,000		
Central San Francisco	000,000	..	106	108
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104½
Cincinnati Gas & Elec. Co.	29,500,000	100	98½	99
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	101	101½
Columbus (O.) Gas Lt. & Heating Co	1,682,750	100	88¾	89¼
Preferred	3,026,500	100	107½	109
Consumers, Jersey City Bonds	600,000	1,000	103	106
Consumers, Toronto	1,700,000	50	218	225
Consolidated, Baltimore	11,000,000	100	70	71½
Mortgage, 6's	3,600,000	..	..	118
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	.	112
Consolidated Gas Co. of N.J.	1,000,000	100	15	17
" Con. Mtg. 5's	880,000	1,000	86	87
Consolidated G. & E. Co.'s.				
Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co.	4,825,500	50	.	89
" Prior Lien 5's	5,603,000	1,000	99½	100
Detroit Gas Co., 5's	1,000,000	1,000	77	79
" Inc. 5's	15,000	100	94	94½
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Essex and Hudson Gas Co.	6,500,000	..	34	38
Fort Wayne	2,000,000	..	.	.
" Bonds	2,000,000	..	55	..
Grand Rapids Gas Lt. Co. 1st Mtg. 5's	1,225,000	1,000	104½	105
Hartford	750,000	25	245	265
Hudson County Gas Co., of New Jersey	10,500,000	..	25	..
" Bonds, 5's	10,500,000	..	101	103
Indianapolis	2,000,000	..	..	68½
" Bonds, 6's	2,550,000	..	102	105
Jackson Gas Co	250,000	50	73	75
" 1st Mtg. 5's	290,000	1,000	101	102½
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	36
Bonds, 1st 5's	3,822,000	1,000	102	104
Laclede, St. Louis	10,000,000	100	80	90
Preferred	2,500,000	100	100	110
Bonds	10,000,000	1,000	109½	110
Lafayette Gas Co., Ind.	1,000,000	100		60
Bonds	1,000,000	1,000	60	65
Louisville	2,570,000	50	112	120
Madison Gas & Elec. Co.				
" 1st Mtg. 6's	350,000	1,000	107½	108¼
" 6 per cent. scrip, due 1910	100,000	25	25	87
Montreal, Canada	2,000,000	100	218	184¾
Newark, N. J., Con. Gas Co	6,000,000	..	56	58
Bonds, 6's	4,600,000		105	105¾
New Haven	1,000,000	25	300	325
Nashville Gas Lt. Co.	1,000,000	100	110	
Oakland, Cal.	2,000,000	..	46	47
" Bonds	750,000	..	..	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	100⅝	101
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	..	..
2d "	2,500,000	1,000	104	
Rochester Gas & Elec. Co.	2,150,000	50	88	
Preferred	2,150,000	50	118	.
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	43	45½
St. Paul Gas Light Co.	1,500,000	100	45	47
1st Mortgage 6's	650,000	1,000	113	116
Extension, 6's	600,000	1,000	112½	115
General Mortgage, 5's	2,465,000	1,000	92	93
St. Joseph Gas Co.				
" 1st Mtg. 5's	751,000	1,000	95	96½
Syracuse, N. Y.	1,975.000	100	29	..
Bonds	2,047 000	1,000	99½	100
Washington, D. C	2,600,000	20	362½	375
First mortgage 6's	600,000	..	..	..
Western, Milwaukee.				
Bonds, 5's	4,000,000	.	109½	110
Wilmington, Del.	600.000	50	232	

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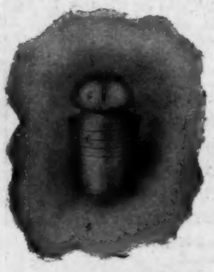

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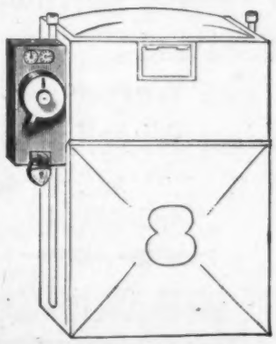

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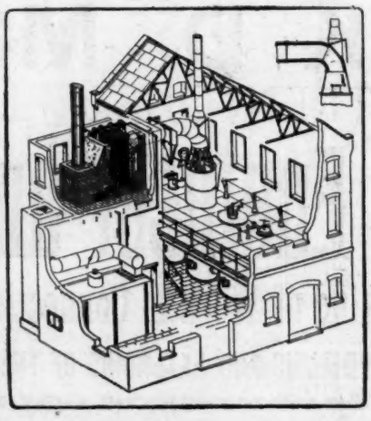

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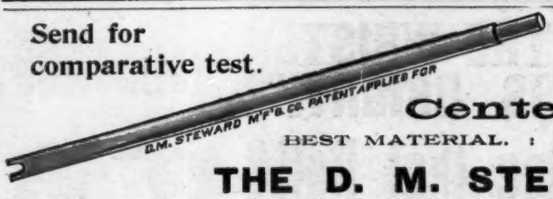

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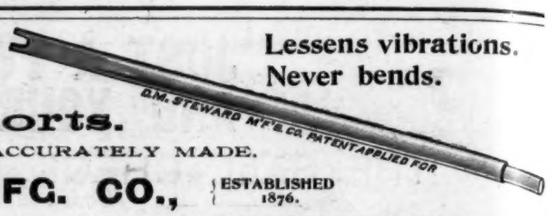

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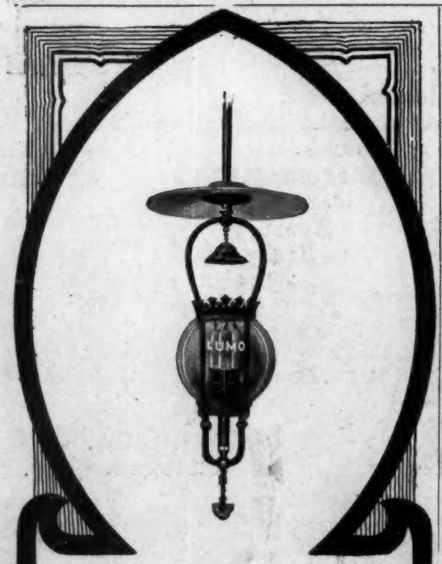

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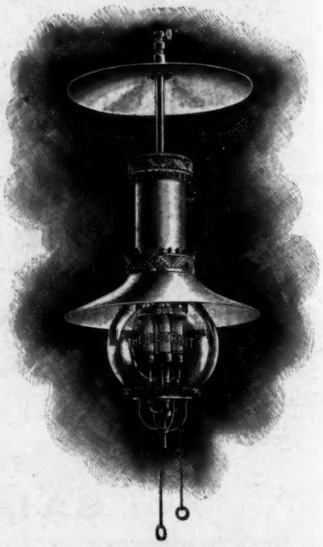

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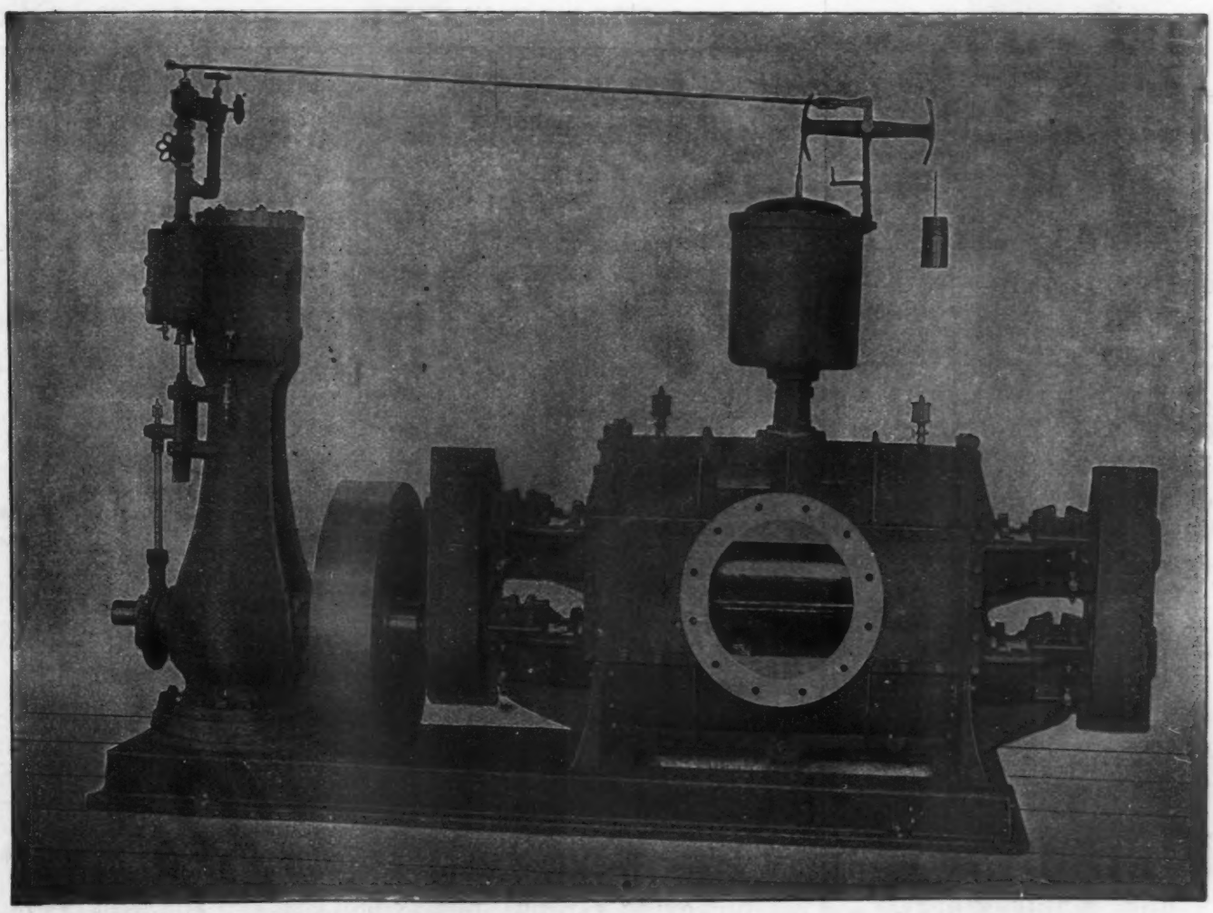

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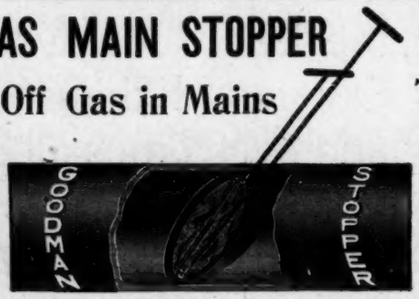

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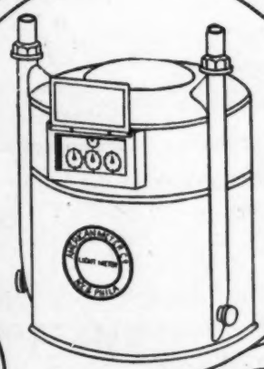

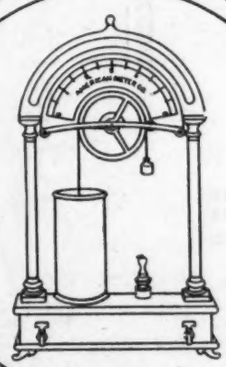

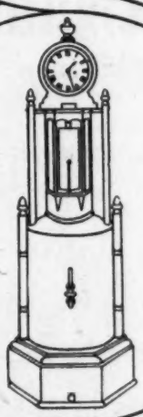

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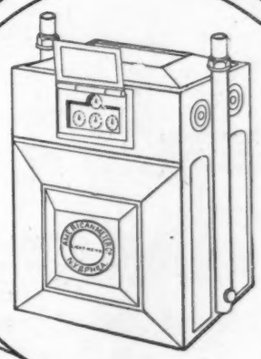

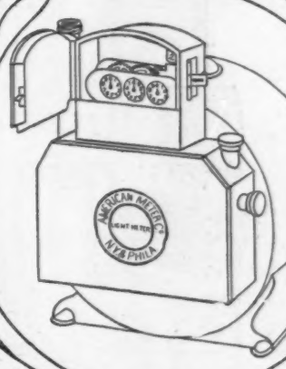

PUBLIC LIGHTING TABLE.

DECEMBER, 1902.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Table No. 1. Following the Moon. Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Table No. 2. New York City. All Night Lighting. Extinguish.
				P.M.	A.M.
Mon.	1	5.00 PM	6.00 AM	4.20	6.10
Tue.	2	5.00	6.00	4.20	6.10
Wed.	3	5.00	6.00	4.20	6.15
Thu.	4	7.50	6.00	4.20	6.15
Fri.	5	8.40	6.00	4.20	6.15
Sat.	6	9.40	6.00	4.20	6.15
Sun.	7	10.40 FQ	6.10	4.20	6.15
Mon.	8	11.40	6.10	4.20	6.15
Tue.	9	12.50 AM	6.10	4.20	6.15
Wed.	10	1.50	6.10	4.20	6.20
Thu.	11	3.00	6.10	4.20	6.20
Fri.	12	4.10	6.10	4.20	6.20
Sat.	13	No L.	No L.	4.20	6.20
Sun.	14	No L. FM	No L.	4.20	6.20
Mon.	15	No L.	No L.	4.20	6.20
Tue.	16	5.10 PM	7.40 PM	4.20	6.20
Wed.	17	5.10	9.00	4.20	6.20
Thu.	18	5.10	10.10	4.20	6.20
Fri.	19	5.10	11.10	4.20	6.20
Sat.	20	5.10	12.20 AM	4.20	6.20
Sun.	21	5.10 LQ	1.20	4.20	6.20
Mon.	22	5.10	2.20	4.20	6.20
Tue.	23	5.10	3.20	4.20	6.20
Wed.	24	5.10	4.20	4.20	6.25
Thu.	25	5.10	5.20	4.20	6.25
Fri.	26	5.10	6.20	4.20	6.25
Sat.	27	5.10	6.20	4.20	6.25
Sun.	28	5.10	6.20	4.20	6.25
Mon.	29	5.10 NM	6.20	4.20	6.25
Tue.	30	5.10	6.20	4.20	6.25
Wed.	31	5.10	6.20	4.20	6.25

TOTAL HOURS LIGHTING DURING 1902.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	238.30	January	423.20
February	196.20	February	355.25
March	196.20	March	355.35
April	166.40	April	298.50
May	151.40	May	264.50
June	131.10	June	234.25
July	142.40	July	243.45
August	162.00	August	280.25
September	179.00	September	321.15
October	216.30	October	374.30
November	224.10	November	401.40
December	250.00	December	433.45
Total, yr.	2255.00	Total, yr.	3987.45

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CLEVELAND, 809 Cuyahoga Building. ST. LOUIS, 712 Roe Building. SAN FRANCISCO, 712 Polk Street.

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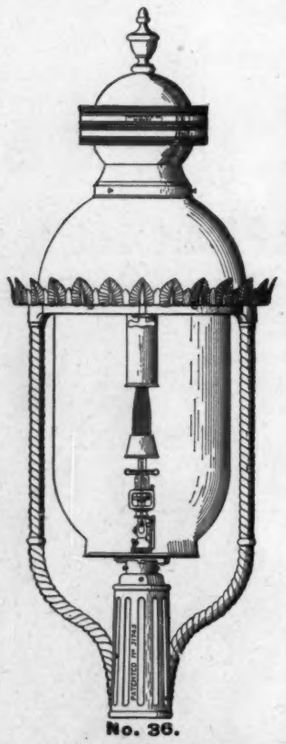
.... OF AMERICA ....



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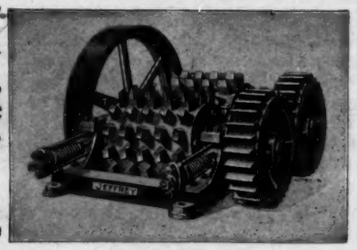

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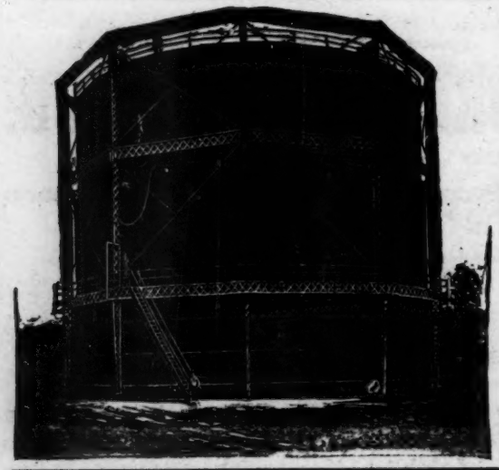

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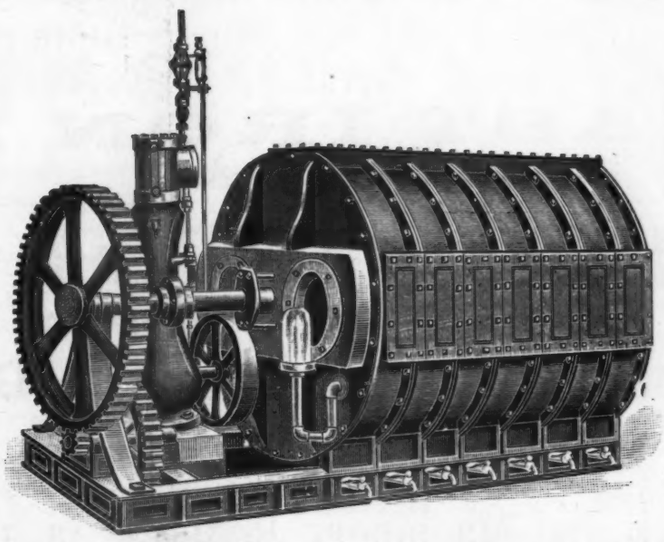

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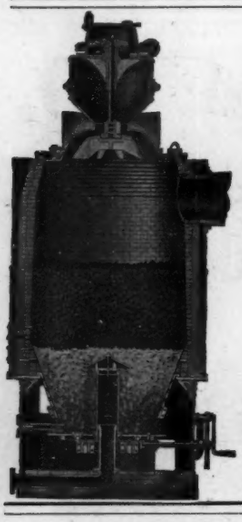

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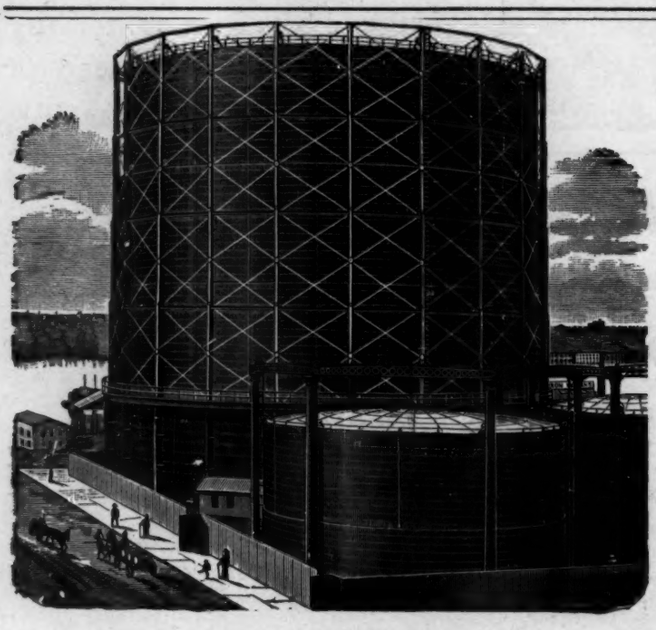

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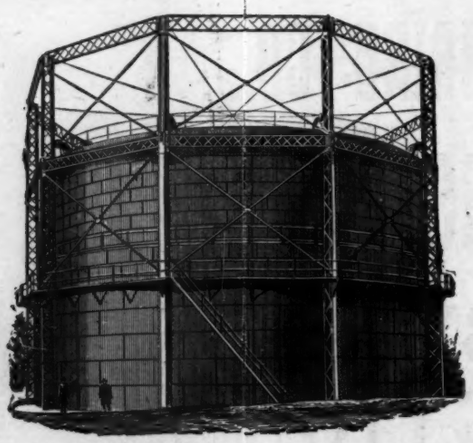

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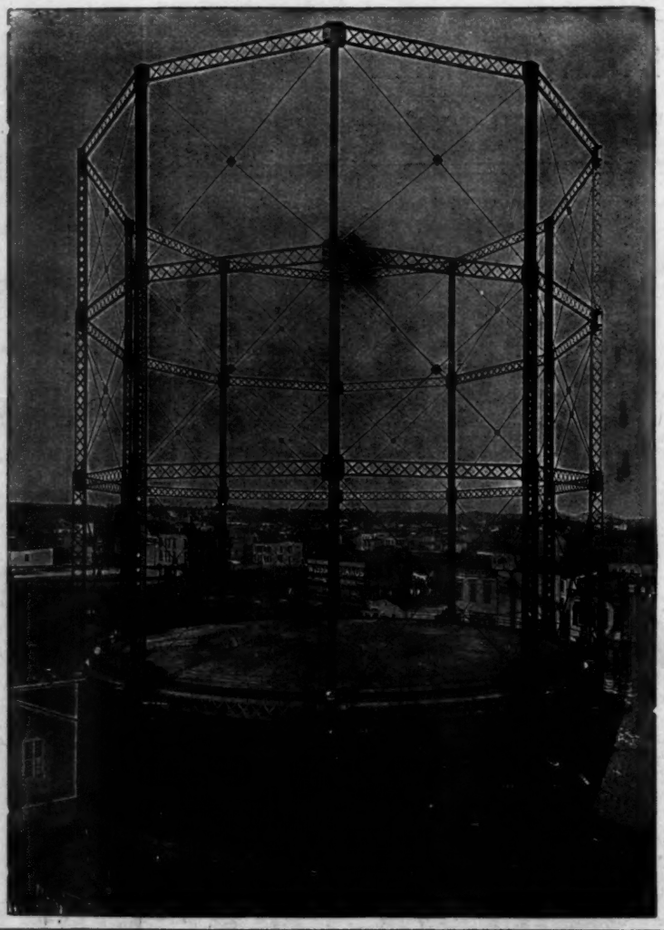

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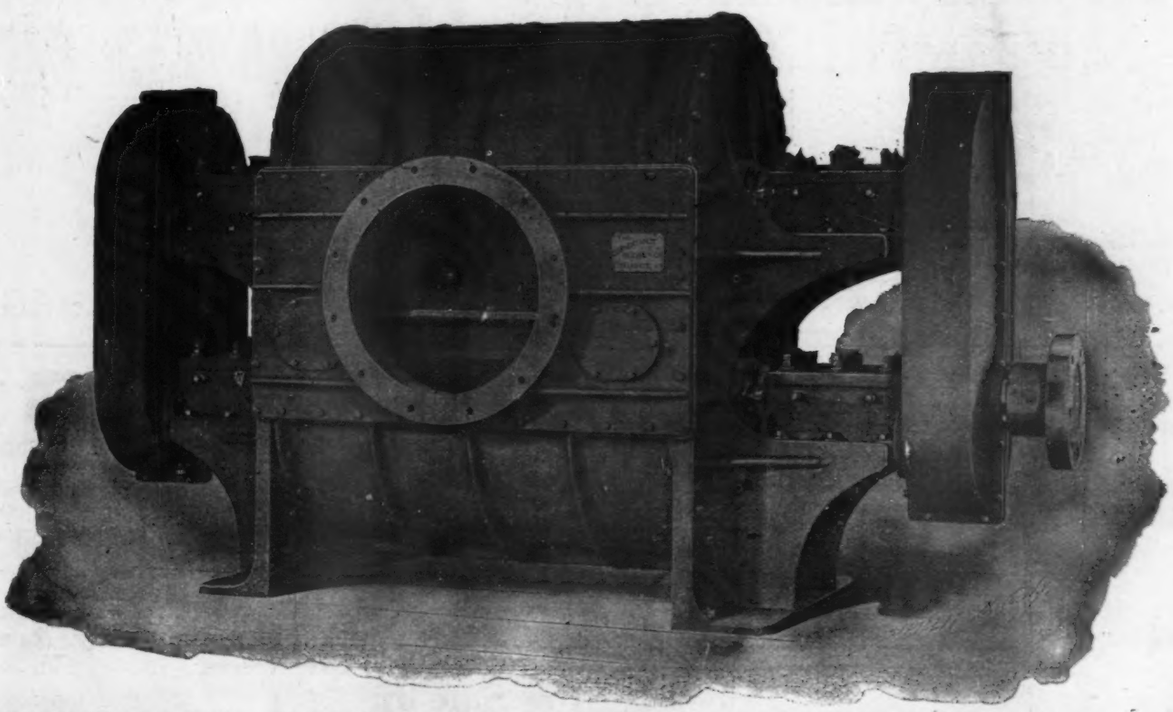

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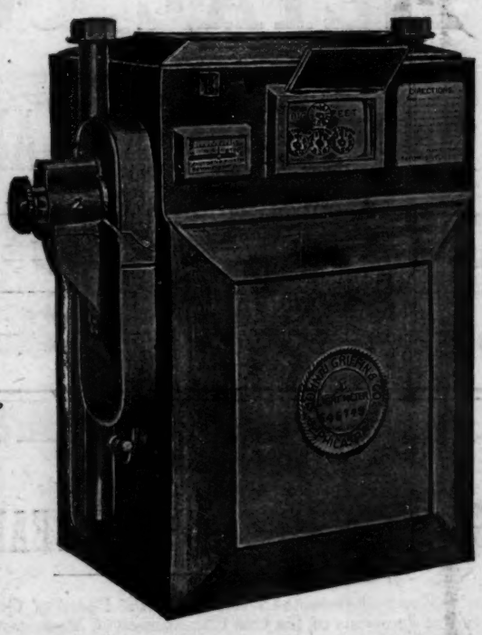

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